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Sanity in Bedlam

PITY the poor public. The air-defence picture they are constrained to view, either out of good citizenship or sheer anxiety, is clouded enough by "security," doubt and indecision; but seen through a murk of "informed comment" and "authoritative views" it becomes utterly chaotic. Shadowy figures cry havoc or peace, mouth half-truths and blind assertions. The defence industry and the Armed Services appear puny, potent, or superfluous as the fantastic light of politics and policies flickers around them. Faction rails against faction, "expert" against "expert," and only an uncommonly clear-sighted man can direct a light of truth on the confusion—a man like the Chief of the Air Staff, Air Chief Marshal Sir Dermot Boyle.

Sir Dermot's declaration last week that loose talk about rockets making the Air Force obsolete was "terribly far from the truth" came as a ray of sanity upon a dark scene of bedlam. If there were war in the next five years, he assured a Fleet Street audience, it would be fighters that would defend us. He implied that the change-over from aeroplanes to missiles would be a very gradual process and, most edifying of all, he gave it as his firm opinion that the R.A.F., with the help of scientists, would be able to defend our country—this in spite of a lot of people who insist that it is a waste of time to try to defend this land in the nuclear age.

Men and Missiles

Any sensible person would be reluctant to predict a date for the final extinction of the manned fighter, but Sir Dermot's assurance of at least five more years seems entirely reasonable. The English Electric P.1, upon which our air-defence system will be largely founded in the years ahead, could not possibly reach the squadrons for many months to come; and, notwithstanding the common assertion that the P.1 will be the R.A.F.'s last fighter, there is a certain rocket intercepter (doubtless the Saunders-Roe S.R.53) which is known to be leading to another that "will probably be ordered in substantial quantities by the R.A.F." (See report of the Select Committee on Estimates entitled *The Supply of Military Aircraft*. This document enabled *Flight* to acquaint its readers with the Blackburn N.A.39—since officially "released" and taken up by the national Press—and with an all-steel supersonic research machine to which the attention of the nation at large has yet to be drawn.)

While viewing the fighter prospect we must not, of course, fail to observe that the Minister of Supply has said that the Hawker Siddeley Group are developing a new piloted fighter as a private venture, and that for this project an entirely feasible speed of 1,800 m.p.h. has been mentioned. Hawker's managing director has added that the venture is going very well, and we may suppose that even this vast group, with all its multifarious interests and resources, is not building a costly new fighting aeroplane for the fun of the thing. And why, it might reasonably be asked, is work forging ahead on the mighty de Havilland Gyron supersonic turbojet? For some fearsome Snark-like missile? Unlikely. For transport aeroplanes? Improbable. For a supersonic bomber? Possible. For a Mach 2-plus fighter? Likely.

Then consider America, where (some authorities assure us) Britain will procure the missiles that spell a sure and early doom for fighters as well as for bombers. Are the U.S. Services discarding their fighters for sure-fire robot killers? If indeed they are, we can only express our pained surprise at their prodigal spending on the improved Century series and on their projects for long-range intercepters of titanic power. These are to be the launching-platforms for the Douglas Ding Dong air-to-air missile, with nuclear warhead.

We echo the words of the Chief of the Air Staff: "At the moment the whole attitude of throwing away the things we know will work does not seem to be good sense."

FROM ALL QUARTERS

FLOWN ABOARD "Ark Royal" in a Whirlwind and driven to the ship's island in a Land-Rover, the Duke of Edinburgh is welcomed by Capt. F. H. E. Hopkins. Centre is the flight-deck captain, C. P. O. Bainbridge.

Ark's Royal Visitor

INFORMAL visits were paid by the Duke of Edinburgh to H.M.S. *Albion* and H.M.S. *Ark Royal* in the Mediterranean on Wednesday of last week. From *Albion*, where he had learned of the ship's rôle in exercises then taking place, he flew by Whirlwind helicopter to *Ark Royal*, where he was entertained by Flag Officer Aircraft Carriers, Vice-Admiral M. L. Power, C.B., C.B.E., D.S.O.

While aboard *Ark Royal*, the Duke watched landings, launches and firing exercises by Sea Hawks of 804 and 898 squadrons, Sea Venoms of 893, Gannets of 815, Wyverns of 831 and Skyraiders of 849 "B" Flight, and watched interceptions being directed from the aircraft direction room. He was shown the ship and the Air Department by the captain, Capt. F. H. E. Hopkins, D.S.O., D.S.C., and by Commander (Air), Cdr. D. G. Parker, D.S.O., D.S.C., A.F.C.

The Duke cut a special cake (made literally ship-shape) to celebrate *Ark's* 1,000th aircraft landing, which had been made the previous day in a Sea Venom piloted by Lt-Cdr. J. F. O. Willcox of 893 squadron. Finally, the royal visitor left *Ark Royal* in a Gannet of 815 squadron flown by the squadron C.O., Lt-Cdr. John David, and landed at North Front, Gibraltar.

Fairey Chairmanship

ON February 15 the Board of the Fairey Aviation Co., Ltd., announced that Mr. G. W. Hall, A.F.R.Ae.S., who is a vice-chairman and managing director, has been appointed acting chairman of the company following the death of Mr. R. T. Outen on February 9.

Hard-currency Canberras

CLOSE on the heels of the £20m Indian Government contract for 68 English Electric Canberras [noted in these columns last week] came an announcement on February 13 that Venezuela had ordered Canberra Mk 8 bombers and Mk 4 dual-control trainers to the value, including spares, of $10m (over £3½m). This is the second order by Venezuela (one of the "hard currency" countries) for Canberras; their first, in 1953, was for Mk 2 bombers.

All the aircraft at present on order will be built at Preston, powered with Rolls-Royce Avons, and carry Marconi radio compasses. Deliveries (by air) are due to begin this year.

French Rate-of-climb Record

FLYING from Istres last Saturday, the Nord Gerfaut 2 (picture, *Flight*, June 8 last) established time-to-height figures which, after checking against full instrumentation records, will be submitted for consideration as world records by the F.A.I. The figures are: 6,000m (19,685ft) in 82 sec, 9,000m (29,528ft) in 100 sec, 12,000m (39,370ft) in 138 sec and 15,000m (49,213ft) in 215 sec.

The pilot was M. André Turcat, who conducted much of the early Gerfaut flying. To establish the new figures he had to climb steeply on instruments, at a constant t.a.s. of 625 m.p.h. in the final sector.

Defence Policy

SPEAKING in the defence debate in the House of Commons on February 13, Mr. Duncan Sandys, Minister of Defence, said that his task was to "reshape the forces, not to mutilate them"; he did not intend to "slash about indiscriminately, lopping off bits and pieces here and there wherever it is easiest." Any reductions made must be part of a coherent plan, one which made sense both militarily and financially.

Mr. Sandys went on to say that the present superiority of the means of attack over those of defence, coupled with "the catastrophic consequences of thermo-nuclear war," virtually determined the course we should follow. The central theme of our policy must be to concentrate our military effort upon prevention rather than defence, to see that a thermo-nuclear war never happens.

Referring in particular to the air defence of Britain, Mr. Sandys said that two courses were open to us, to try (as in the past) to provide fighter protection over the whole of the British Isles; or to confine fighters to the more limited rôle of "protecting our power of retaliation" by defending the bomber bases. This task, he said, must rank as part of our deterrent and be given high priority.

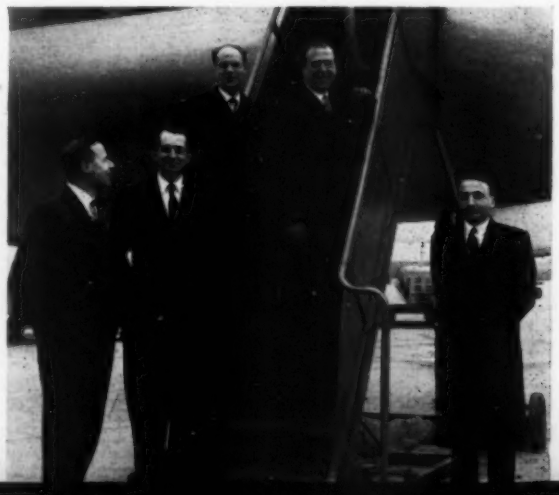
The Minister said further that it was quite clear that ultimately —when the potential enemy was in a position to bombard this country with nuclear rockets—the effectiveness of our deterrent power would depend upon the possession by us of similar weapons.

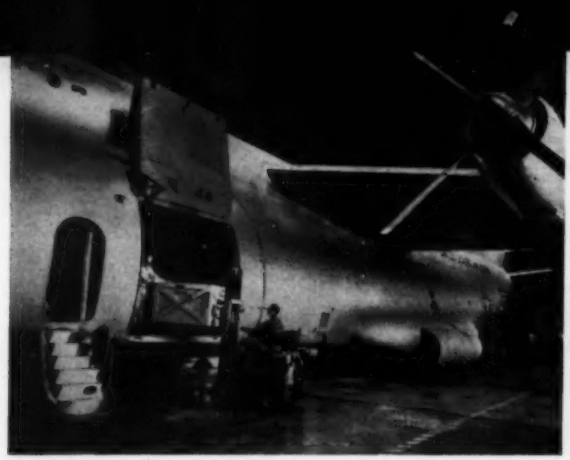
All-jet Training

A LETTER in our correspondence columns last week, from a reader who questioned the cost to the taxpayer of all-through jet training of R.A.F. pilots, has brought a comment from Hunting Percival Aircraft, Ltd. The short answer, their spokesman says, is contained in an Air Ministry news statement on February 8, which said:—

"The first [Jet Provost] course was tested by the Examining Wing of the Central Flying School and the Examining Wing of the NATO Air Training Advisory Group. Both concluded that it had attained a considerably higher standard of pilot ability than piston-trained students at an equivalent stage. The C.F.S. examining team commented on student standards as follows: 'Compared with the average student trained on the Piston Provost the jet-trained students have, in a shorter time in the air, achieved a more dextrous and better mental approach to the art of modern flying. Their repertoire of aerobatic manœuvres, for example, is generally much more extensive and flown with much more accuracy and spirit.'"

THE COMET "3½A" was inspected by the Minister of Supply, Mr. Aubrey Jones, during a recent visit to Hatfield. In this group are, l. to r., Mr. D. W. G. L. Haviland, M.o.S. Under-Secretary (Air B); Mr. C. T. Wilkins, D.H. Aircraft chief designer; the Minister; Mr. A. F. Burke, D.H. Aircraft managing director; and Mr. J. Christie, the Minister's personal assistant.





THE WORLD'S BIGGEST: Jolted, perhaps, by the exclusive "Flight" drawing in our February 8 issue, illustrating the probable appearance of the Douglas C-132 transport, the U.S.A.F. has now authorized release of the sketch on the right. Simultaneously publication is authorized of the photograph showing the mock-up (left) and of these approximate figures: payload, 100,000 lb; max. payload, 200,000 lb; range, 3,500-4,000 miles at speeds above 460 m.p.h.; cargo space, 95ft long by 17ft wide by 12½ft high; gross weight, over 500,000 lb; propeller diameter, 20ft.

The Hunting Percival spokesman goes on to point out that the need for jet conversion, "previously carried out on the costly advanced jet trainer" will not now arise, and that much of the training done on advanced jet trainers is now carried out on the Jet Provost. He continues:—

"Because of this, present indications are that the overall cost per pupil trained to Wings standard will be several thousand pounds less on the Jet Provost / Vampire sequence than on the Piston Provost / Vampire sequence.

"The decision to introduce all-through jet training follows most comprehensive Service training trials and, so far as we are aware, this is the first occasion on which such trials have preceded a decision to put a new training aircraft into service.

"If your correspondent and his fellow-taxpayers knew the intense interest which these trials have aroused in overseas Air Forces they would, we think, take encouragement from the determination of the Royal Air Force to continue to lead the world in military pilot training, as this country has done since the days of Smith Barry and Gosport."

Launch of a Skylark

THE Australian Supply Minister, Mr. Howard Beale, said in Canberra last week that, on February 13, the first Skylark upper-atmosphere research rocket was successfully fired at Woomera. Following a flat trajectory, and clearly with a very short burning-time, it hit ground 20 miles away after having reached some 50,000ft altitude.

The "production" Skylark is intended to lift instruments to 100 miles on the thrust (11,500 lb for 30 sec) of a Bristol-built Raven solid-propellant motor. Many Skylarks are to be fired during the International Geophysical Year, which begins in July.

Mirage III Performance

THE Marcel Dassault Mirage III has on several occasions reached a speed equivalent to Mach 1.5, piloted both by M. Glavany of Dassault and MM. Marias and Franchi of the C.E.V. The Mach number was achieved at a height of 11,000 metres and represented an airspeed of just under 1,000 m.p.h. Thus it did not exceed the 1,132 m.p.h. (Mach 1.7 in this case) of the Fairey Delta 2, as formerly reported.

Future Mirage models will be powered by a SNECMA Atar 9 afterburning turbojet developing a thrust of 13,200 lb. With this power the aircraft is expected to attain Mach 2.

Discussing Supersonics

SOME noteworthy points were made by speakers at the discussion which followed the R.Ae.S. lecture by Messrs. R. L. Lickley and L. P. Twiss on the Fairey Delta 2. (Part 1 of the lecture is reported on pages 235-237 of this issue.)

Inevitably, supersonic shock-waves, or "bangs" as they were referred to even at this erudite meeting, were mentioned after the lecture. Opening the discussion, MR. F. W. PAGE, chief engineer of the aircraft division of English Electric, said he agreed wholeheartedly with the lecturers that the present restrictions on supersonic flying were hampering the development of supersonic aircraft in Britain. The situation was likely to become worse rather than better in the future. The area and duration of flight tests made from Warton aerodrome, Lancashire, with the P.1 were very restricted, and he emphasized that in the case of turning or diving supersonic flight (stick force per g, buffet boundary, directional stability, power control stall checks, structural integrity checks, simulated operational manœuvres, etc.) it was virtually impossible to avoid bangs being heard on occasions.

MR. E. T. JONES, president of the R.Ae.S. and chairman at the meeting, agreed "wholeheartedly with the need for somewhere where supersonic flying can be done without additional risks which the aircraft already entail." Mr. Page had said that he had heard it remarked that the necessity to fly supersonically only over the sea (if flight was below 30,000ft, and much of it was) deprived the pilot of his last remaining luxury, namely, that if he ejected—and survived that operation—he should stand a reasonable chance of rescue.

Mr. Jones said that the F.D.2 was, to his mind, a model of how this sort of aircraft could be built. It had been constructed in the way in which it had been conceived. It was one of a handful of aeroplanes in the world which had in five years doubled the speed of flight.

MR. LICKLEY, who answered most of the questions, said that the F.D.2 design was not helped very much by American experience with the X-1 to X-4 series of research aircraft, none of which was a delta. He disagreed with a questioner that the lack of modifications on the F.D.2 was due to the lack of a difficult customer; the reason was "that we had a straightforward specification." The only modification of any magnitude, the provision of larger elevator jacks, was being made at the present time. The simplicity of the F.D.2 design was successful, and so far the company had not had any feelings that this simplicity was wrong. There was no question that as the F.D.2 was a research aircraft it could be delayed; in fact, the customer had held three-monthly meetings on the project and pressed for it to fly at the earliest moment. He thought that there had been too much emphasis on changing requirements and the customer changing his mind, and that they were often used to cover up manufacturers' change of outlook.

G/C. Gordon Slade, Fairey chief test pilot, after paying tribute to Mr. Peter Twiss's test flying, called for more aircraft of the F.D.2 type. He said only seven pilots, including Twiss and himself, had flown the two F.D.2s in existence. There was two to two-and-a-half years' flying work still to be done on the aircraft, and yet there was a demand to let more pilots fly it.

In a characteristic contribution SIR GEORGE EDWARDS, Vickers-Armstrongs (Aircraft) managing director, pointed out that the F.D.2 world speed record still stood after nearly a year. "Not even the Americans have taken it back. They say they don't think it matters, and they are not sparing the time to try, and this, that and the other, and that no one else wants to go to the trouble of getting it back. I reckon it is a safe bet that if anyone *could* have got it back, he would have done so."

TILT-WING: A U.S.A.F. contract is announced for the Hiller X-18 tilt-wing research aircraft, as depicted here. This appears to use an Avitruc fuselage and is likely to be powered by two Allison T40 turboprops, driving contra-rotating screws. The civil applications of a developed version are obvious.

A picture taken last week at Hatfield of the Comet 3 prototype in its new "3½A" guise. It had just emerged from the hangar after a six-month refit (see page 257). The Comet represents the British bid for the medium-jet market in the years immediately ahead.

THE MEDIUM JET TRANSPORT

A Review of the Present State of the Controversy

By J. M. RAMSDEN

EVENTS of the past week or two—the completion of the rejuvenated Comet 3½A (illustrated in the heading), Lord Douglas' analysis of the future rôles of jet and turboprop transport, and the reports that B.E.A. are soon to decide on their choice of jet—all make it timely to review the present mood of the industry and the airlines as regards the medium jet.

THERE have been few more incisive contributions to the muddled controversy of jet *versus* turboprop than Lord Douglas's Brancker Lecture, which we summarized in last week's issue. It was a concise appraisal of an argument which, like anything controversial, can very easily become biased and loose. The fact that this jet *versus* turboprop analysis came from the chairman of B.E.A. gave it an especially keen edge, because his Corporation has stated its requirement for a jet transport and may soon—perhaps within the next few weeks—announce its choice. (There was no denial of the newspaper report last week that the choice may lie between the Vickers and Bristol projects.)

One expects to get a balanced and neutral assessment of the conflicting jet and turboprop claims from an airline, especially from one whose future plans embrace both jet and turboprop, and whose turbine experience exceeds by a wide margin that of any other operator. The B.E.A. conclusions, if they can be adequately summarized so briefly, were that the jet, for whatever range-category it is designed, will be 10 to 15 per cent more expensive to operate than a matching turboprop, and that below 500 miles its block-time advantage will not be significant.

The figure of 10 to 15 per cent will be challenged, and perhaps adjusted, by the adherents to the jet—a possibility which we shall examine in a moment. But assuming that a jet airliner can, in the 1957 state of the art, be designed which would considerably reduce B.E.A.'s estimated disparity in cost, the case for the jet in the short- and medium-distance hauls appears to become very strong.*

Here we have B.E.A., who have concluded that the jet will be so much more expensive to operate, departing from their all-turboprop philosophy to order a fleet of jets, purely to meet jet competition—from the Caravelle, and from the long-haul DC-8s and 707s which in 1960 will be stealing European sector traffic. Other world airlines, faced with similar competition, will do the same, thereby providing a certain market between now and 1970 for a number of short/medium jets which Lord Douglas estimated at more than 700 aeroplanes—a sizeable market considering the premise upon which it was estimated.

How many more airlines might buy short/medium jets, and how much bigger the market might be, if their level of economy could be brought within only a few per cent of the turboprops? If the break-even load factor of a jet can in due course be made to approach that of a competing turboprop on a given route, it could be argued that few airlines would hesitate to buy it as their staple, if not indeed standard, equipment for non-competitive as well as for competitive routes. The resultant market which might open up would indeed appear to be considerable—enough to support perhaps four or five manufacturers.

It would, of course, depend upon realization of the postulation "if the jets' level of economy could be brought within a few per cent of the turboprops." But is it so very far from reality to suggest that, by the mid-sixties, aerodynamic, structural and turbojet technologies will be sufficiently advanced to produce a high-subsonic short/medium jet that does come very near to the turboprop in economy? It is in this very realm of speed that the high by-pass ratio turbojet offers an efficiency which combines the best of both the turboprop and the straight-through jet worlds—as was shown in the paper Rolls-Royce recently read to the I.A.S. (*Flight*, February 8), and by Sir Arnold Hall in his Wright lecture (*Flight*, January 11). And there is undoubtedly equal room for optimism in another line of turbojet development—the high-compression, two-spool engine. Specific fuel consumptions of less than 0.75 are coming within sight in both these forms of propulsion.

Obviously, turboprop technology will advance rapidly also; but the turboprop might find difficulty in maintaining its superiority in economy while at the same time trying to keep up with the jet in speed. It may not attempt to do so; as Lord Douglas said in his lecture: "The slower [375 m.p.h.] turboprop achieves a specific cost four per cent lower than the 460 m.p.h. turboprop and 13 per cent lower than the jet. The result suggests that it may be unwise to push the speeds of turboprops too high. The jet has such a clear advantage in speed that the turboprop must rely on securing its place in the air transport spectrum by achieving the lowest possible operating costs."

It seems there are grounds for expecting that the short/medium jet may come nearer to the turboprop in cost per seat-mile—which is what matters most to the operator, with speed a close second—than B.E.A.'s analysis of the two forms of propulsion, made in the year 1957, might suggest.

Added weight would be lent to this argument if it could be shown that, *even by 1957 values*, the 10 to 15 per cent disparity in cost shown by B.E.A. is on the high side. Certainly this is what the supporters of the jet will attempt to do: and, without disrespect for the neutrality of B.E.A.'s analysis, we might review it again through the eyes of the jet-protagonists.

The B.E.A. analysis showed that, on the basis of Viscount and Comet 1 experience, the differential between the relationship of actual costs to formula costs might be 12 per cent higher for the jet—a figure which was arbitrarily reduced to eight per cent on the grounds that the early Comet was more of a step into the unknown than future jet transport will be. But why, the protagonists of the jet might ask, should their type be as much as even eight per cent higher in its ratio of actual costs to formula costs? The reasons given are the "greater operational inflexibility" of the jet, and the "sophisticated design which tends to exaggerate the economic effect of engineering changes."

**For the purposes of the present discussion, and notwithstanding its general title, a jet designed to operate up to 1,500 miles is defined as "short/medium"; and up to 2,500 miles as "medium."*

If one accepts that the operational inflexibility aspect should be allowed for in the calculation of formula costs, and that the jet is no more "sophisticated" in design than the turboprop, then the jet and the turboprop would, in the view of the jet-protagonists, start at par so far as the relationship of actual to formula costs was concerned. They might also query whether, in B.E.A.'s estimate of formula costs, it was altogether fair to take the early B.O.A.C. Comet 1 figures. Admittedly—and this was pointed out in the analysis—it was the only jet experience to go on. But compared with the Viscount 701—which only now is being supplemented in B.E.A. service by a new type—the Comet 1 was an early conception which was considerably improved upon by the 44-seat, longer-range, Comet 1A which quickly followed it into French airline service. Indeed, the Comet 2, had it become established in service in 1954, might have been a more appropriate jet design with which to compare the Viscount 701's ratio of formula to actual costs.

If these contentions are upheld, the sequel might be that the cost of operating the jet works out, not as 10 to 15 per cent more expensive than the turboprop, but as only about 6 to 9 per cent.

If further adjustments are made for the improvements one might expect of a 1963/64 short/medium jet—in particular for the specific consumption of rapidly advancing turbojet engines—it seems that a short/medium jet which might compete strongly with the economy of the turboprop comes within sight.

If it is a British jet it will need to achieve a level of economy of that order not only to command a market wider than the "competitive" market—substantial though this may be—but also to attract those airlines which may be disposed towards the American small jets. In other words, the British jet for B.E.A. has to achieve a level of economy which will ensure that it attracts (1) world airlines as well as those with limited competitive requirements only, and (2) the world airlines with big jets—who probably comprise the largest potential market for short/medium jets, but who would naturally favour the junior partners of their big aeroplanes. Although the DC-9 and the Boeing 727 and 707-020 design-projects are temporarily shelved, they are certain to be dusted off and revived when Douglas, Boeing and the airlines have got the big jets established in service.

These Douglas and Boeing short and medium jets, and to an equal extent the Convair 880, are likely to offer the stiffest resistance to world-wide acceptance of a British 1963/64 design, unless it exploits to the utmost the promised economy of the turbojet—a field of development in which Britain may be considered to excel.

The precise extent of the market is of course the object of detailed research by the firms contending for the B.E.A. order, who have to be sure of a sizeable export market before committing themselves to a small initial contract. The B.E.A. assessment of the short-haul market (i.e., for jets designed for capacity payload stage lengths up to 1,000 miles) was surprisingly high considering their conclusions as to the jet's highest operating cost, and their negligible superiority in block time below 500 miles. The estimate was that the 1957-1970 demand would be for 750 short-haul jets. The basis for this assessment was not stated, but it must have been an estimate of capacity required on the competitive 500 to 1,000-mile stages. If we are willing to accept that the operating cost of the jet need not be as high as B.E.A. suggest, an even larger short/medium jet market opens up off the main competitive highways.

Similarly, B.E.A.'s estimate of the 1957-1970 medium jet market, which was defined as the demand for aeroplanes designed to carry capacity payload up to 2,500 mile stages, was for 700 aircraft; again, this is a large market to have resulted from the conclusions of B.E.A.'s cost analysis, and *ipso facto* it promises to be even larger if the low operating cost figures are attainable.

Our own feeling is that B.E.A.'s definition—in the Brancker lecture—of the short-haul jet may be of an aeroplane somewhat limited in world-wide application: even if its costs could be made competitive, it would show little advantage over the turboprop in block time below 500 miles, and would be unable to carry full payload beyond 1,000 miles. And the medium jet, defined in the B.E.A. analysis as designed to carry capacity payload up to 2,500 miles, might—to the detriment of its market prospects—be overlapping the realm of the smaller big jets and their improved developments.

It could well be that the band of range in which the biggest jet market is to be found is 500 to 1,500 miles. (Beyond this distance the design would develop into a very much bigger aeroplane—the true "medium jet".) It is for sectors within this band of range, which we have loosely defined as short/medium, that B.E.A., and other airlines, will need jets to maintain their competitive positions.

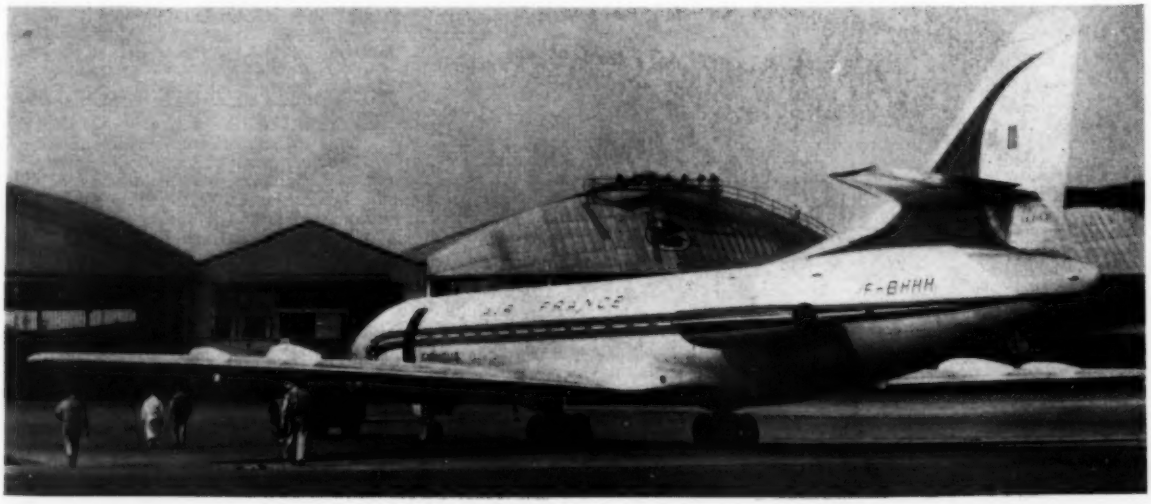
A short/medium jet designed for this band of range might satisfy B.E.A.'s requirement, but it might not penetrate much further into a market hotly contested by rival jet designs unless it had a level of economy which could be shown—by a neutral airline as well as by the manufacturers—to come within two or three per cent of the turboprop.

If, by 1963 or 1964, this could be achieved—and we have tried to show that this may not be entirely wishful thinking—such an aeroplane would command not only the "jet race" market. It would also penetrate on its own economic merit into a very much wider market, and be accepted by a public which may by then be favourably disposed toward jet travel on the world's short- and medium-stage routes as well as on the long-haul sectors.

We might not be challenged were we to suggest that, from the mid-sixties onwards, when the big jets are established as the accepted fashion of long-haul travel, the public may come to demand jet travel as well as turboprop travel on the short and medium distances. Two distinct types of jet would be required: the short/medium aeroplane, typified by B.E.A.'s requirement, and a larger medium-haul design such as will almost certainly be needed by B.O.A.C. in the mid-sixties. Both fields of opportunity appear to offer rich export rewards for the British industry, whose especial strength lies in its mastery of gas-turbine technology.

Footnote: The chairman of B.O.A.C., Mr. Gerard d'Erlanger, said at Melbourne Airport last Friday that he was discussing with the British industry a specification for a new jet transport weighing about 240,000 lb, carrying 100 to 120 passengers, and suitable for non-stop-Atlantic as well as Empire operation.

France's Caravelle, which is contending for the short-haul jet market of the next six or seven years. Later prospects for the short-haul jet are discussed in these pages. Like the Comet, and most other new transports, it is Rolls-Royce-powered.



HERE AND THERE

SEEHABICHT: German naval officers receiving instruction at Coventry on an Armstrong Whitworth-built Hawker Sea Hawk naval fighter/bomber, an order for 68 of which is expected to be signed in Bonn next week.

Mediterranean Terriers

ON February 13 the U.S. Navy announced the first firing of a guided missile from an American warship in the Mediterranean. The vessel, the cruiser *Boston*, armed with Terriers, was taking part in her first NATO manœuvres.

Sweden's Jindiviks

SALE of ten Jindivik target aircraft to Sweden for £A500,000 was confirmed in Canberra last week-end by Mr. Beale, Australian Minister of Defence Production.

Swedish Air Force Cuts?

PROPOSED cuts in Sweden's defence expenditure may result in the Air Force suffering a reduction of one-fifth. The Government has proposed that during the coming fiscal year the Service should receive Kr.91m (just over £6m) less than it requested.

Mr. E. T. Jones Visits India

LAST Tuesday Mr. E. T. Jones, Director-General of Technical Development (Air), Ministry of Supply, and president of the Royal Aeronautical Society, left London by air for New Delhi to attend the ninth annual general meeting of the Aeronautical Society of India, at their invitation.

Aircraft Employment Increase

EMPLOYMENT figures for October and November last year showed a steady increase in the number of those employed in the "manufacture and repair" of aircraft. The previous highest monthly total, 257,300, was in September 1956; in October it rose to 257,600 and in November to 258,300.

Education Conference

A WEEK-END conference on *Advanced Aeronautical Education* has been arranged by the Royal Aeronautical Society for March 23-24 at the College of Aeronautics, Cranfield. As a basis for discussion, papers will be read by Prof. A. J. Murphy, Mr. R. L. Lickley and Prof. A. V. Stephens, while Prof. A. R. Collar will be chairman of the meeting. Enrolment (details from the R.Ae.S.) should be made by March 15.

Ion Propulsion

OFTEN featured in science-fiction, ion-propulsion (reaction obtained by ejecting a steady jet of high-potential ions) is gradually becoming fact. The U.S.A.F. Office of Scientific Research has placed two contracts—the contractors are not named—for research into the applicability of such propulsion to space-flight.

France's New Carriers

AT Saint Nazaire, the keel has been laid for the new French aircraft carrier *Foch*. With her sister ship *Clémenceau*, under construction at Brest, she will be the largest vessel built for the French Navy since the war, and she will have steam catapults and an angled deck. Each of the two ships will carry 50 aircraft.

Helicopter Heavy Transport

TWO Sikorsky S-58s, on charter to the Australasian Petroleum Co. (from a company named in an Australian report as World-Wide Helicopters) reached Port Moresby, New Guinea, this month. They will be used to fly heavy oil-drilling equipment to sites in Papua.

R.Ae.S. Louis Blériot Lecture

ON Thursday, March 7, the Louis Blériot lecture is to be given by M. Paul Badré, production director of Ouest Aviation S.N.C.A., who will speak on *New Methods of Aircraft Production*. The lecture will be at the Institution of Mechanical Engineers, 1 Birdcage Walk, London, S.W.1, at 6 p.m.

World Gliding Venue

AT an F.A.I. meeting in Paris last week it was decided to hold the next world gliding championships at the Leszno gliding centre in Poznan, Poland, during June 1958

Vimy Memorial

IT is now confirmed that, as a memorial to Sir Ross and Sir Keith Smith and their crew, the Vickers Vimy which they flew from England to Australia in 1919 is to be preserved at Adelaide.

Hopes for Hendon

IN answer to a Parliamentary question, the Minister of Transport and Civil Aviation, Mr. Harold Watkinson, said last week that he was consulting with the Air Minister about an airfield for club and private aircraft when Croydon closes, and Hendon was one of those being kept in mind.

Barnwell Lecture Alteration

IT has been announced that the Barnwell Memorial Lecture at Bristol on March 13 will not now be given by Sir Alfred Pugsley, who is recuperating from an illness. Instead, Prof. A. R. Collar, Professor of Aeronautical Engineering in the University of Bristol, will give a paper on *Education in Industry*.

Waveforms Discussion

AT the measurement and control section discussion on *The Analysis of Waveforms* at the Institution of Electrical Engineers, Savoy Place, London, W.C.2, next Tuesday at 5.30 p.m. the discussion will be opened by Mr. A. Cooper, B.Sc., and Mr. D. A. Drew, B.Sc., chief vibration engineer, Rolls-Royce, Ltd.

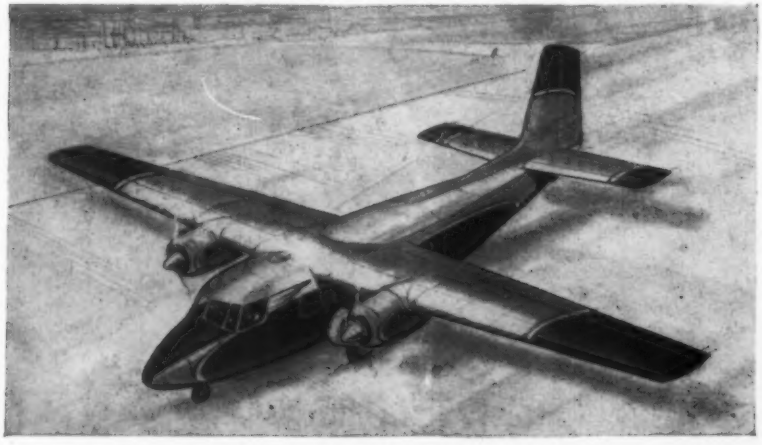
Lucky Number Drawings

ALREADY almost fifty sets of drawings for the Druine Turbulent have been sold, less than a year after its introduction to this country in April last year. The Popular Flying Association, which is encouraging the amateur construction of Turbulents and the two-seater Turbi, intends to make a presentation of the 50th set of drawings.

Kaman HU2K

KAMAN AIRCRAFT have received a development contract for a new helicopter, with the above designation, for the U.S. Navy. The company entered both a single-rotor and a twin-rotor design in competition with other firms and won with the former project—the first Kaman machine of such configuration. Power is to be provided by a General Electric T58.

SUPER BROUSSARD: A "Flight" copyright impression of the Max Holste M.H.250 Super Broussard, to be powered with Pratt and Whitney Wasps or—later—Turboméca Turmo 3 or Lycoming T53 turboprops. The Wasps will give a maximum cruising speed of 225 m.p.h. and the distance to clear 50ft will be 290 yd.



A reminiscence of the 1956 S.B.A.C. Display —one of the two Fairey Delta 2s at take-off.

Design, Construction and Testing Described in a Notable Lecture to the Royal Aeronautical Society

PART I

THE FAIREY DELTA 2

JOINT authors of a main Royal Aeronautical Society lecture, delivered on February 14 and dealing with the development of the Fairey Delta 2 supersonic research aircraft, were Mr. R. L. Lickley, B.Sc., F.R.Ae.S., technical director and chief engineer of the Fairey Aviation Co., Ltd., and L. P. Twiss, test pilot of the company. It was Mr. Twiss who secured the world's speed record of 1,132 m.p.h. with the F.D.2 on March 10, 1956.

In the first part of the lecture Mr. Lickley dealt with design and construction, and in the second part (to be dealt with next week) Mr. Twiss described some features of flight testing, leading up to his record flight and later flying.

Mr. Lickley introduced his contribution by recalling that the development of manned supersonic aircraft in this country suffered a setback at the end of the 1939-45 war, when it was decided that the use of manned machines would be too dangerous. More realistic views soon prevailed, however, and as a result the ordering of such aircraft was considered in 1947 by the Ministry of Supply. In Fairey's submission to the M.o.S. in 1949 the aircraft was described as having as its primary function research flying at transonic and supersonic speeds up to M=1.5.

The background which led up to this submission [Mr. Lickley continued] is of interest, as it shows a logical line of development within the company. In 1947 the company was developing the F.D.1 at Stockport and scale models of it at Heston, in order to conduct vertical take-off experiments. The models were of advanced design, powered by a rocket motor with twin combustion chambers, controlled in pitch and yaw respectively by an automatic pilot. Information of behaviour in flight was telemetered to the ground. In September 1947 the company was asked if it could further develop the vertical take-off models to fly transonically after ground launching. After consideration it became clear that, although the technique and experience of the V.T.O. models would be of great value, the experiments themselves would be of little use unless they were aimed at obtaining specific information on a layout representative of a typical possible piloted supersonic aeroplane. We, therefore, began a design study of such a piloted aircraft as a preliminary to the design of the pilotless models. Our first efforts resulted in a design of high sweepback on both leading and trailing edges, all-moving tip ailerons, conventional tailplane and twin engines in the fuselage fed from a nose intake (English Electric P.1-type layout). This design was not proceeded with, but in February 1949 we were approached by P.D.S.R. (A) (then Sir Harry Garner), and asked to consider an alternative design for a further supersonic research aircraft, preferably based on a single engine. We had, of course, by this time considerable background in the problems of designing such an aeroplane. We had developed the necessary new techniques of drag and performance estimation and had collected together what slender information there was on the stability and control characteristics of various configurations. We decided to begin our considerations afresh and, by the end of the year (December 1949), had come to a firm proposal [see 3-view drawing on page 236.—Ed.] which differed very little from the aeroplane as it is flying at present, although pressure from various sources to make changes was at times very strong.

The design which evolved was a delta-wing plan form of aspect ratio 2, having a Rolls-Royce R.A.5 engine in the body, with wing root intakes having frontal areas cut to a minimum and all possible excrescences removed. The major target and guiding principle in the whole design period was to get an aeroplane of minimum weight, with the smallest frontal and surface areas, while still remaining a straightforward aeroplane to handle in the air and on the ground, and yet at the same time large enough to house the R.A.5 engine and sufficient fuel to enable worthwhile flights to be made. As an indication of the design problems raised by this approach, the *maximum* clearance between engine and fuselage skin is less than 6in and, within this space, room had to be found for the main frames to which the wing is bolted.

Although the aerodynamic form was decided at an early period, the contract to build two aircraft was not placed until October 1950: lack of money, priorities and other problems, caused this hold-up and almost immediately after the placing of the contract "super-priority" intervened, and the need at Faireys to concentrate on the Gannet meant that a fully effective start was not made on the design work until the summer of 1952. Manufacture effectively began about the end of that year. Little or no priority was given to the aircraft and, because of the demand on wind tunnel capacity for tests of Service types under development, only very meagre and belated high-speed tunnel tests had been undertaken before the aircraft flew. In fact, some supersonic tests were only analysed after the aircraft had flown supersonically.

Aerodynamic Design. A moderate wing-loading was chosen to give good high altitude performance, medium landing speeds and good performance from normal length runways. At 4 per cent, the t/c ratio is still one of the lowest flying, and at the design date (1949) was the lowest known. The advantages of the tailless layout were held to outweigh the reputed disadvantages and, when one considers the various tail layouts to be seen today, and the established need for fully-variable tailplanes, the choice seems to have been the correct one, possibly more than anything else because of the aerodynamic simplification produced.

Side intakes were decided on, as it was felt that the structural simplicity and saving in weight, compared with a nose intake, were worth more to the design than the possible aerodynamic difficulties introduced. At various times, the intakes were the subject of strong criticism, both from the aerodynamic aspects and from the possible bad effects on compressor flow, but they have remained substantially as initially conceived, and have proved satisfactory up to the highest Mach numbers reached.

Much discussion has ranged round trim drag and the penalties it applies to delta aircraft. Our thinking led us to believe that much of the drag could be avoided by careful design and, in particular, by the use of large-chord controls which would keep the angular movements reasonable. So far, our only problem

THE FAIREY DELTA 2 . . .

with these controls has been lack of jack effort in certain cases; as predicted, effects of trim drag have not been serious.

Mathematically defined forms were used for aerofoils and fuselage, to enable high accuracy of contour to be attained in the final manufactured product.

Of petal form, at the rear of the fuselage, the dive brakes were designed to give minimum change of trim, etc., and in flight at sub- or supersonic speeds have given no pitch or lift changes and more than adequate deceleration.

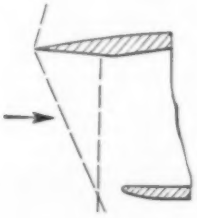
Considerable work was done on body form and it might be described as an early approach to area rule—the short intake fairings (inspired by Küchemann) combined with a cylindrical body to the trailing edge and the swept fin mainly behind the trailing edge.

Structural Design. The use of a very thin wing, combined with a fuselage almost full of engine, presented many difficult structural problems. The thin wing (4 per cent) set the major problems, and it was decided to use a form of construction in which the spars were perpendicular to the fuselage, with ribs or stringers parallel to the fuselage centre line. This shortened the length of the spars and greatly simplified the joints to the fuselage frames. The wing-root bending moment, due to the small thickness, required a number of spars, situated aft on the wing. Each spar is attached to machined fuselage frames which, to ease manufacture, were made in three pieces; this had the additional advantages of making the frame statically determinate.

The wing consists essentially of two torsion boxes, one at the leading edge and one—the major torsion box—between the chassis and the control surfaces, which are cantilevered off the trailing edge of this box. The skins of this aft torsion box are of thick light-alloy, the thickness being dictated by requirements of torsional stiffness. Except at the root, the wing skins carry practically all the wing bending loads, but at the side of the fuselage the loads in the skin diffuse out into the three main spars.

The fin is attached at leading and trailing spars in a manner similar to the wing. The main bending attachment was made integral at the root with a cross member, so that once the critical narrow base attachment had been made, the introduction of backlash on the fin-base through fin removal was rendered less likely, as the detachable attachments were on a wide base. The main-fin skin thickness was determined by stiffness requirements for the avoidance of flutter.

The rear fuselage forward to the break-joint is of monocoque construction and has the petal brakes mounted on it. The problems of mounting the petals have the feature which is reproduced many times on this aircraft, *i.e.*, the difficulty of incorporating into a small space mechanism dealing with large loads. The centre fuselage consists of heavy frames connected by longeron members; the frames take the wing loads and support the engine.



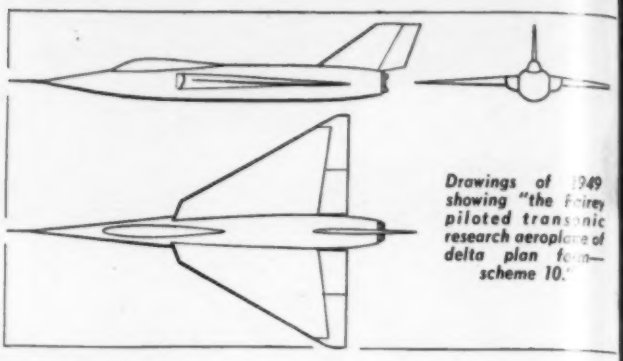
A diagrammatic indication of the shock system over the air intakes at a Mach number of about 1.4. The exceedingly complex problem posed by intake requirements was the subject of a special appendix to the lecture.

The cockpit, which droops to provide improved view for landing, provided another difficult problem as almost the entire top had to be open to provide for seat ejection, etc. This problem was dealt with by building the relatively open cockpit on to a complete box ahead of the forward bulkhead of the cockpit. The cockpit, when in the up position, is attached to the front fuselage by a conventional set of latch pins.

The control surfaces are constructed with a heavy leading-edge torsion box designed by stiffness, and a light trailing edge designed by strength considerations. Provision was made for mass balancing, but this has not been needed.

A point of interest is that the structure weight was one per cent less than the weight estimated in 1949.

Flutter. Very full and careful flutter investigations were made. Calculations early in the design stage showed that with the expected impedance of the hydraulic jacks actuating the control surfaces, the addition of mass balance made little difference to the flutter speed of the wing-aileron combination. Later calculations by the Multhopp-Garner theory confirmed this view and showed that the addition of mass balance could bring in a low flutter speed if it caused the control surface natural frequency to be reduced to two-thirds of its value with no mass balance. In view of these results and the fact that mass balancing would add considerable weight to the aeroplane, it was decided to eliminate it from the aircraft. This helped in the avoidance of transonic control surface buzz and single-degree of freedom flutter by keeping the natural frequency of the controls as high as possible. Other favourable factors are the very small trailing-edge angle and the large chord of the control surfaces. It has not been found necessary, so far, to fit hydraulic velocity dampers to increase the control surface damping in the transonic region.



Drawings of 1949 showing "the Fairey piloted transonic research aeroplane of delta plan form—scheme 10."

Very full flight testing has confirmed this approach, stick-tapping having been carried out throughout the full flight range. The responses obtained from stick tapping appear to be sufficiently accurate to confirm the policy of flight vibration testing by this method and, since the taps have been capable of exciting nodes at 35 cycles/sec, it was felt that it was not necessary to use other methods. The use of this method has meant that a large number of records have been obtained in a comparatively short period. The analysis of the results indicate only slight variation of damping with Mach number.

General Design Considerations. The thin wings and small fuselage provided the overriding design factors, but a further point was kept well to the forefront—so to design the aircraft that easy maintenance and straightforward servicing were provided. This approach has paid high dividends, giving what has been described as "airline reliability" and permitting up to six flights per day to be made.

With the need to keep the height of the windscreen to a minimum, and yet give the pilot adequate view at the high angles of incidence at landing, various schemes, such as retractable seats, etc., were studied; but the final, and the simplest, solution was that of drooping the nose portion, containing the pressure cabin. This is hinged on the bottom longerons and is operated by a hydraulic jack. It is a light and straightforward means of giving the pilot a better view and has been reliable in operation. It did, however, set up some problems connected with the jettisoning of the hood. To ensure that the hood would jettison correctly, it was desired that it should pivot about an aft hinge on release. This pivot point, however, could not be earthed on to the fuselage due to the drooping of the nose, including the hood. This was overcome by having two "barrow handles" carrying the aft pivot points, tipping with the droop nose and lying flush in troughs in the main fuselage in the nose-up position. To keep the drag to a minimum, the hood was designed with very small clearance from the pilot's head and was kept flush with the surrounding structure by having hinges on one side, thus avoiding sliding mechanisms which would increase the difficulties of pressure sealing.

The main undercarriage was a geometric, as well as a mechanical, problem. It was found that levered suspension was the most satisfactory manner of absorbing the required energy with the short length of leg at our disposal and that this would also most easily fit the very limited area and thickness available in the wing housing. The wheel, when housed, lies in a plane parallel to the inner surface of the upper wing skin. To rotate the wheel into this position the top of the leg is attached by means of a universal joint to an inclined rotating eyebolt, while a side bracing member forms a secondary hinge and controls the path of the wheel during retraction, and a telescopic fore-and-aft member takes the drag. The eyebolt is mounted on a boss on the spar forging.

Along the fuselage, a top deck was provided to carry all control rods, electrics, hydraulics, filters, etc., and this has proved invaluable for easy servicing. Access to the research equipment carried was through the nosewheel bay, and here also was carried

THE FAIREY DELTA 2 . . .

the recording equipment required by the F.A.I. during the world-record attempt.

The engine is a Rolls-Royce R.A. series engine with reheat. The basic engine is standard, some small external changes being made to enable it to fit our fuselage. With the exception of reheat problems in the early stages, there has been little trouble with the powerplant, in spite of tight clearances, and the general reliability has been high. The engine is fitted or removed by breaking down the rear fuselage near the fin, and sliding the engine out on rails on to special ground equipment. This has enabled engine changes to be made easily and without breaking any services other than those to dive brakes and rudder.

Hydraulics and power controls have been left to last in the description of the design, although great care and forethought were devoted to them. Throughout the whole period of flying they have given every satisfaction. It was decided in the early days to use power controls of Fairey manufacture, as we were just beginning to manufacture these in quantity and felt that our equipment had many advantages over anything currently available elsewhere. The further decision was taken to duplicate fully the control system and to do without manual reversion. As a result, the aeroplane has fully-powered, fully-duplicated controls, with Fairey valves and hydroboosters. To eliminate flutter tendencies as far as possible the jacks are attached to solid structure and the valves operated by push-pull rods, to keep break-out forces to a minimum.

There are two hydraulic pumps driven by the engine, one of which feeds a main accumulator which powers the flying controls. The second pump feeds a second accumulator which supplies power not only to the flying controls, but also to the main and nose undercarriage retraction mechanism, the droop nose, and the air brakes. In addition to these accumulators, there is an emergency accumulator which can be selected to power either the flying controls or the other services, and there is also a brake accumulator. In the event of an engine or hydraulic pump failure, an emergency air-driven turbine pump feeding the second system can be lowered into the air stream.

The air brakes are operated by similar methods and the four petals are synchronized to ensure even opening. Another problem here was to operate the petals without excrescences and this was achieved by a system of floating links, giving a good moment arm, but remaining flush when closed.

Manufacturing Problems. This aircraft was our first attempt at building from solid without any transitional experience of similar types of construction. As a result, many detail problems arose in the manufacture, but, by careful jigging, and making full use of the solid frames and spars, we consider that the wing profile was made to a measured accuracy of ±0.005in relative to the mathematical form laid down. In addition, the wings are attached to the fuselage by 10 close-tolerance fixing points and full interchangeability of wing to fuselage was provided.

Integral fuel tanks occupy most of the wing and their development was closely studied. It was finally decided to assemble the wing as a dry structure, designed and manufactured to be as fuel-tight as possible in this state and subsequently sealed by slushing. This system has worked out very well in practice.

In spite of the major machining problems of the spars and frames from rough forgings, and the assembly difficulties of the thin wings and fin, the aircraft flew about 20 months from the start of construction. It is worth noting that the last three months were mainly involved in inspection, testing of systems, impedance testing and general pre-flight work, an indication of the complexity of the systems.

Finally, with all these problems behind us, the aircraft made its first flight at Boscombe Down on October 6, 1954.

(To be concluded)

MORE MISSILE DETAILS

FURTHER information on certain American guided missiles has become available to supplement that published in—and since—our special "Guided Missiles" issue of December 7 last.

Two of the later fruits of the Bumblebee programme (Johns Hopkins University) are Tartar and Triton. The former is a surface-to-air missile powered by a solid rocket (Allegany Ballistic Laboratory) and without a booster. It is to be standardized on small naval craft and does not necessarily supersede the larger Terrier. Triton, whose dimensions were published on December 7, is now known to be a cruise-type weapon powered by a pair of ramjets burning a new high-energy fuel ("zip-fuel" in the U.S.A.). Cruising at Mach 3.5 at over 80,000ft the Triton can be launched by submarines and has a range exceeding 1,500 miles.

Already in full production, Chance Vought's Regulus 2 (see artist's impression, *Flight*, December 28) is at present being intensively tested with a retractable undercarriage, just as was the earlier Regulus 1 (one example of which has flown more than 15 times). At present powered by a Wright J65 Sapphire, the production Regulus 2 will later have a General Electric J79, raising the speed further into the supersonic region.

Polaris, the strictly Navy IRBM powered by a large Aerojet solid-propellant motor, is reported to be developing on schedule. Known also as the Fleet Ballistic Missile, or FBM, it is intended to achieve a range of 1,500 miles, to be launched, if necessary, by submerged submarines, and to be operational within five years.

Some additional details are available concerning two Army anti-aircraft weapons. Raytheon's Hawk I, already in production to meet the threat of low-altitude aircraft, is a heat-seeker. Conversely, it is clear that the standard Nike B Hercules, the longer-ranged Nike with ability to carry a nuclear warhead, will be a radar homer. Ground radar, for initial beam-riding, will need to generate R.F. power measured in millions of watts. Another variant of the same family is Nike Zeus, an anti-missile missile.

Standard armament of Convair's new F-106 intercepter (Pratt and Whitney J75 with afterburner) is a single Douglas Ding Dong air-to-air missile with nuclear warhead. The F-106 therefore has a single pair of missile doors, replacing the three sets of the Falcon-armed F-102.

North American's X-10 turbojet-powered test vehicle (illustrated in our February 8 issue) has now finished its work. The final weapon in this programme, the SM-64 Navaho, is in flight status. It is powered by twin Wright ramjets (Mach 3.5) mounted at the roots of the sharply upswept wing, which also serves as a tail.

Also illustrated last week was the Bell GAM-63 Rascal. It is now learned that this air-to-surface missile is usually carried beneath the wings of B-47s and not in the bomb bay.

R.A.E. TECHNICAL COLLEGE PRIZEGIVING

IF the ingredients of a successful college prizegiving are the report of academic achievements, some down-to-earth remarks by a Cabinet Minister and a light-hearted summary of student affairs, then the R.A.E. Technical College prizegiving, at Farnborough on February 8, was successful indeed. The only thing lacking was perhaps the Harrow school song "Forty years on"—since the occasion marked 40 years' continuous education at the R.A.E.

The principal, Mr. R. D. Peggs, O.B.E., M.A., expressed justifiable pride when he reported that six students had last year graduated B.Sc. (Eng.); 77 Higher National Certificates in mechanical, electrical and production engineering were gained, with 102 endorsements to existing certificates and 64 distinctions; 68 Ordinary National Certificates with 73 endorsements and 22 distinctions; 93 Final City and Guilds Certificates and 139 intermediate ones. Several ex-students had gone to Cambridge and the Massachusetts Institute of Technology for post-graduate studies. Mr. Peggs stressed the College's "virile" corporate life and the liberal education it provides. His only anxious note was about the difficulty of filling six vacancies on the staff.

Viscount Hailsham, who presented the prizes, said that the last time he had visited Farnborough was as First Lord of the Admiralty; that now, as Minister of Education, he had come to a college for which his Ministry was not responsible—and the fact that so much vital education was being carried on outside its aegis encouraged him to think that at last this country was becoming education-minded. He believed the purpose of education was to make better human beings and to place the individual in society; the fine work being done at the College made him confident of Britain's ability to play its part in the world.

Student affairs, as entertainingly described by Mr. R. C. S. Onslow, president of the Union, provided the right note on which to end such an occasion.

C.A.I. LECTURE MEETING

THE Canadian Aeronautical Institute is holding its mid-season meeting at the Fort Garry Hotel, Winnipeg, on February 25 and 26. On the first day, under the general heading *Maintenance and Overhaul*, papers are to be given on cold-weather maintenance and flying, ground-servicing equipment in cold weather operations, and the overhaul and maintenance of commercial aircraft; on the second, under the heading *Safety and Survival*, there will be papers on survival training in the R.C.A.F. and on the Saskatchewan air ambulance service.

Visits have also been arranged to the Standard Aero Engine, Ltd., and Bristol Aircraft (Western), Ltd., factories.

WESTLAND WIDGEON

A Five-seat Helicopter in Detail: "Quick-change" Features for Versatility

THE elaborately annotated sectional drawing on this page permits a particularly intimate study of a modern helicopter—for such is the Westland Widgeon.

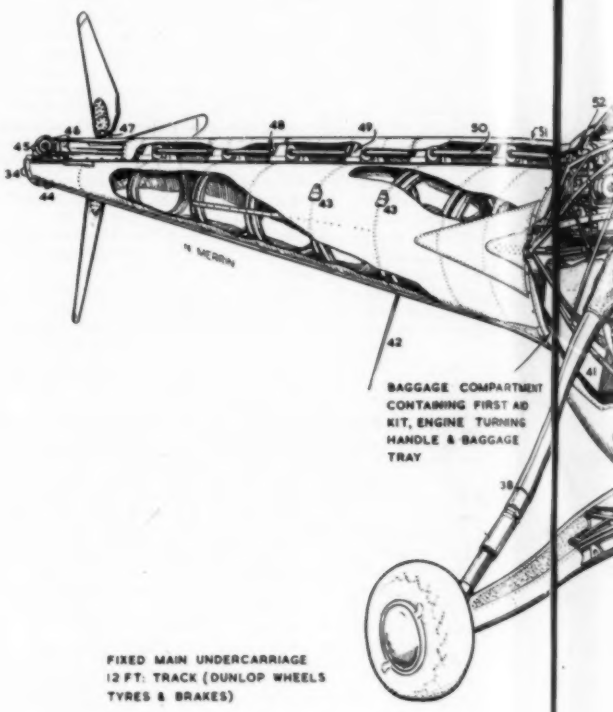
Literally the heart of the Widgeon is the Alvis Leonides 521/1 nine-cylinder radial engine, mounted with the crankshaft vertical in the centre-section of the fuselage. This unit has a maximum power rating of 515 h.p. at 3,000 r.p.m., and with 43in boost. The vertical shaft from the Leonides drives through a centrifugal clutch, incorporating an engine-cooling fan, to the main gearbox. This box has two-stage epicyclic gears giving a 14.85 speed reduction for the main rotor and a 2.25 reduction for the tail rotor.

The cabin has a floor area of 24½ sq ft, and the three rear seats and two adjustable forward seats are so fitted that they can be quickly and simply removed when the Widgeon is required for rôles other than passenger carrying. For pilot-training, dual controls and instruments can be installed.

For rescue duties an hydraulically-operated winch is fitted on the starboard side—a location which permits the pilot to control the winch and renders the presence of an additional crew-man unnecessary. The winch is suitable for rescue with various types of harness, as well as with the scoop net, and is stressed to hoist three adults simultaneously. Alternatively, it can serve as an aerial crane. For what the makers call "replenishment services" a substantial load can be carried in a special freight sling.

For ambulance work the Widgeon requires no modification. The triple rear seats are removed and the port-side front seat is transferred to a position behind the pilot, for the use of a medical attendant. Two stretchers are then positioned, one above the other, lengthways on the port side of the cabin. In the nose is a single clamshell door for stretcher loading.

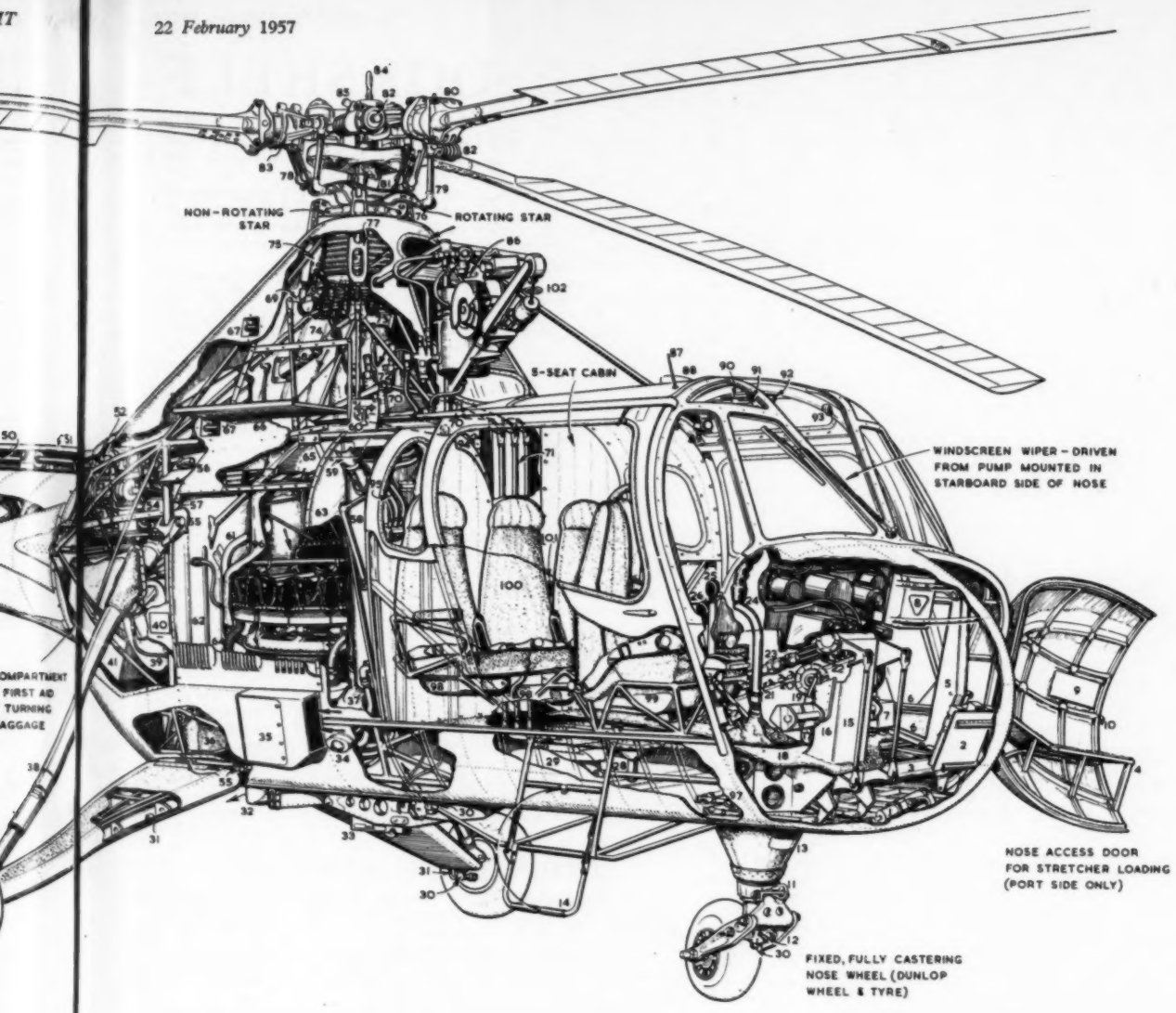
The Widgeon has a maximum all-up weight of 5,900 lb. Its maximum permissible speed is 95 kt (109 m.p.h.), maximum cruising speed 88 kt (101 m.p.h.), and economical cruising speed 70 kt (80 m.p.h.).


BAGGAGE COMPARTMENT CONTAINING FIRST AID KIT, ENGINE TURNING HANDLE & BAGGAGE TRAY
FIXED MAIN UNDERCARRIAGE 12 FT. TRACK (DUNLOP WHEELS TYRES & BRAKES)

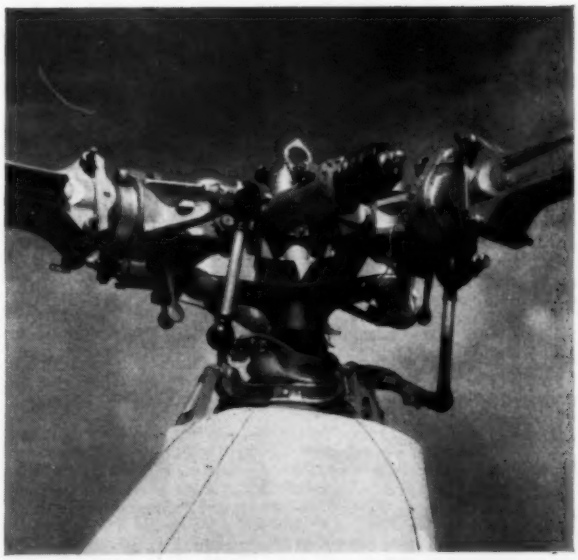
"Flight" photograph

1 Lateral-trimming actuator
2 Main fuse block
3 Fore-and-aft control torque tube
4 Platform extending cabin floor when door closed
5 Hinged stretcher-guide rail (stowed)
6 Stretcher-guide rails
7 Gyrosyn compass corrector control box
8 Gyrosyn compass amplifier
9 Weight and c.g. schedule
10 Toggle fastener
11 Picketing lug
12 Air-charging valve
13 Westland oleo-pneumatic shock-absorber leg
14 Footstep (bottom rung retracting)
15 Directional-control pedestal
16 Rudder pedals
17 Fire extinguisher
18 Pedal leg-reach adjuster
19 Fore-and-aft trimmer handwheel
20 Fuel-pump circuit breakers
21 Lateral trimmer switch
22 Hand controls (port to starboard, landing-lamp lever, air-intake by-pass control, oil-cooler shutter control, oil and fuel cut-off control)
23 Collective-pitch control (housing starter button)
24 Cyclic-pitch control
25 Rotor-brake control
26 Wheel-brake control
27 Wheel and rotor-brake reservoirs
28 Directional-control quadrant (cables run behind cabin bulkhead, over engine bay and along tail cone to 45)
29 Mixing unit—fore-and-aft lateral cyclic-pitch controls.
30 Jacking points
31 Brake pipes
32 Ventilator
33 External freight carrier (loading up to 750 lb)
34 Navigation lamps
35 Air-intake supplying cold air through transverse duct to carburettor
36 24 v, 25 amp hr battery
37 Hot-air valve
38 Turner pneumatic shock-absorber leg
39 Oil tank (6.5 gal)
40 Kick-in step
41 Baggage tray
42 Aerial for STR 9X radio, installed above baggage compartment (port side)
43 Blade-folding-gear lugs
44 Tail-rotor guard attachment point
45 Cable-drum and pitch-control shaft
46 Tail-rotor gearbox
47 Counterbalance weights
48 Fairleads for directional control cables
49 Tail-rotor drive-shaft bearings
50 Tail-rotor drive shaft

The Westland Widgeon, as this "Flight" photograph bears witness, is among the best-looking rotating-wing aircraft in the air today.


NON-ROTATING STAR
ROTATING STAR
5-SEAT CABIN
WINDSCREEN WIPER – DRIVEN FROM PUMP MOUNTED IN STARBOARD SIDE OF NOSE
NOSE ACCESS DOOR FOR STRETCHER LOADING (PORT SIDE ONLY)
FIXED, FULLY CASTERING NOSE WHEEL (DUNLOP WHEEL & TYRE)

51 Detachable fairings
52 Intermediate gearbox
53 Hydraulic accumulator, pump, reservoir equipment (drip-tray under). Pump belt driven from intermediate gearbox
54 Inverter Type 100A
55 Undercarriage-leg attachment points
56 Rear fuel-tank filler cap
57 Rear fuel tank (41.6 gal)
58 Forward fuel tank (41.6 gal)
59 Forward fuel-tank filler cap
60 Fuel and oil filler cap tool
61 Generator cooling-pipe
62 Rear firewall
63 Forward firewall
64 Magneto cooling-pipe
65 Cooling fan
66 Maintenance platform
67 Handgrips
68 Intermediate drive shaft
69 Cyclic pitch control operating quadrant
70 Cyclic pitch control rocker levers
71 Cyclic pitch control push-pull tubes
72 Main gearbox sump
73 Main gearbox
74 Servo-jack pipes
75 Starboard lateral servo-jack and control arm
76 Port lateral ditto
77 Fore-and-aft servo-jack and control arm
78 Droop and flapping restrainers
79 Push-pull tube (pitch control arm to rotating star)
80 Main rotor-blade attachment
81 Rotating scissors
82 Blade dampers
83 Pitch-control arm
84 Helicopter lifting eye
85 Fluid-level indicator
86 Pressure head
87 Outside-air thermometer
88 Ventilator
89 Stand-by compass
90 Map-reading lamp
91 STR 9X radio controller
92 Emergency-pull to cut winch-hoist cable
93 Stretcher-slinging point
94 Radio terminal blocks
95 Hydraulic piping to winch hoist
96 Engine-cowling jacket
97 Directional control toe-lever
98 Lifebelt stowages
99 Pilot's seat (also fitted in co-pilot's position)
100 Rear passenger-seats
101 Location for stretcher handles. (Cabin can be modified to take two stretchers on port side, with two pilot-type seats installed on starboard side, for pilot and attendant)
102 Winch hoist (operated from switch on pilot's control column)



The Widgeon rotor-head embodies the offset flapping hinges of the larger Whirlwind, giving greater lift and centre-of-gravity range.

THE AERONAUTICAL BOOKSHELF

"The World's Fighting Planes," by William Green and Gerald Pollinger. Macdonald and Co., Ltd., 16 Maddox Street, London, W.1. Illustrated. Price 15s.

THIS new edition of *The World's Fighting Planes* is even better than the first. The Russian section is particularly valuable because, although it does not include photographs of all the new types shown in the 1956 Aviation Day fly-past, they are represented by first-class silhouette drawings. These are so arranged that the differences between the two Mikoyan fighters code-named "Faceplate" and "Fitter," and the Sukhoi deltas "Fishpot" and "Fishbed" are immediately apparent. Unfortunately, the names of the deltas have become transposed in the headings; but no self-respecting compositor can be blamed for mixing such unimaginative titles; and it is to be hoped that some day the bestowers of NATO code-names will give these business-like aircraft businesslike names.

In general, the mixture is as before, with the nationally produced aircraft of 21 different countries arranged in alphabetical order country by country. But the individual ingredients of the mixture are very different, for an incredible number of new military types have appeared in the past two years. Glancing at some of the new shapes, such as the Starfighter, SeaMaster, J-35 Draken, P.1, Griffon and Durandal, which are emphasized more than usual in silhouette form, we are reminded anew of the tremendous problems of supersonic flight that designers have faced and overcome in so many different ways, with results that are far more apparent than they were two years ago.

Great care has been taken in selecting nearly 300 new photographs, some of which have never before been reproduced, and this makes more regrettable the occasional pruning of a landing wheel, fin-tip, wing-tip or propeller blade to produce a standard-shape block. The authors have disposed neatly of one criticism of the original book (that training and transport aircraft were wrongly included as "fighting planes") by recalling the use of Texan (Harvard) trainers as armed spotter aircraft in Korea, with Alcyon and S.I.P.A. S.12 trainers currently performing in equally warlike rôles in Algeria. Even the "Dak" has, in its time, degenerated into a bomber in the Middle East.

"The World of Space," by Maurice F. Allward. Collins Clear-Type Press, Cathedral Street, Glasgow. Illustrated. Price 3s.

SO many books are being churned out on the subjects of missiles, rockets and space travel that it seems impossible that the basic, non-technical facts of life from all of them can be distilled into 186 well-printed pocket-size pages, wrapped in cloth-covered boards and sold for much less than the price of a packet of 20 cigarettes. Yet here is just such an achievement.

The World of Space opens at Peenemunde on October 3, 1942, the day of the first successful firing of an A-4 (V.2) rocket, and devotes the next 29 pages to a brief review of rocket history, with references to Galileo's contributions to astronomy and the early science-fiction stories of Jules Verne and H. G. Wells. Then follow 44 pages devoted to the moon, planets and stars—the targets for the space-ships whose step-by-step development, *via* space-stations, forms the subject for the next section of the book. In general, all this follows the usual pattern, except that the author gives his third-stage ferry-ships extremely topical Draken-type "double-delta" wings.

Next comes a chapter on the journey to the moon, written in a readable "running commentary" style that makes the more technical aspects of the business understandable to a young reader—and his dad. Unlike many astronautical optimists, Maurice Allward does not pretend all this will happen the day after tomorrow, nor does he overlook the tremendous problems. In Chapter 22 he tells how current missile and aviation research is helping to solve some of them; and he ends his book with chapters on the possibility of true interplanetary flight around our own solar system and to other stars.

"Aeromodeller Annual 1956-7," compiled by D. J. Laidlaw-Dickson and edited by C. S. Rushbrooke. The Model Aeronautical Press, Ltd., 38 Clarendon Road, Watford, Herts. Illustrated. Price 10s.

TURNING the pages of this hardy annual and thinking back to the rubber-powered "stick" models of one's childhood makes even a thirty-year-old feel ancient, for the aeromodelling hobby has grown at a fantastic rate in the past ten years. Nor should its political potential be overlooked, for the 1956 competition results listed in this book remind us how boys and men from Russia and America, Czechoslovakia, Australia and a score of other countries meet regularly to match their designs against one another in true sporting spirit.

Even in an age that has become accustomed to originality and unorthodoxy in full-size high-speed aircraft, the variety of types and designs is startling. Scale plans in this *Annual* include a variable-incidence tandem-wing glider from Canada; a radio-controlled pusher monoplane and a tail-first sailplane produced for the Palace of Modelling at Warsaw; a control-line model of the Yak-24 tandem-rotor helicopter from Russia; a semi-scale flying-boat from Sweden; and a delta-type control-line speed model from Czechoslovakia.

Technical articles discuss the merits of such things, for model applications, as hydraulic control systems and swept-forward wings; and one of the illustrations to the latter purports to show the Convair XB-53, an ultrasonic needle-nose tailless design with a short fuselage and very stubby swept-forward wings. At the back of the book are tabulated data on standard aerofoil sections, specifications of twelve types of model aero-engines, lists of national and international records and a great deal of other useful information.

After studying the technical knowledge and craftsmanship that go into the modern model, one has little reason to doubt a statement in H. Best-Devereux's contribution on full-size amateur-built lightplanes: "Aeromodellers will not find building an ultra-light aircraft so very different from building a power model."

"Weather Map. An Introduction to Weather Forecasting." 4th Edition. Published by H.M.S.O. for the Meteorological Office. Illustrated. Price 10s 6d.

THIS fourth edition of *Weather Map*, in common with its predecessors of 1916, 1930 and 1939, is primarily intended for intelligent (but meteorologically uninstructed) members of the general public. Large parts of the book have been re-written following changes in practice and emphasis in weather forecasting during recent years.

Greater attention than in previous editions has been paid to the causes of weather phenomena most frequently experienced in this country, and a new set of weather maps (plotted in the up-to-date manner and showing typical pressure-distributions) has been included. Modern forecasting techniques are described, and selected actual forecasts are discussed in relation to the surface and upper-air maps on which they were based, with indications of the considerations which led the forecaster to his conclusions.

J.W.R.T.

OTHER BOOKS RECEIVED

High-Speed Flight, by E. Ower and J. Nayler. Hutchinson's Scientific and Technical Publications, 178-202 Great Portland Street, London, W.1. Price 30s.

Rocket Propulsion Elements, 2nd Edition, by G. P. Sutton. Chapman and Hall, Ltd., 37 Essex Street, London, W.C.2. Price 82s.

Flying Scale Models, by R. G. Moulton. Model Aeronautical Press, Ltd., 38, Clarendon Road, Watford, Herts. Price 10s.

The Helicopter Book, by Henry B. Lent. The Macmillan Co., 10, South Audley Street, London, W.1. Price 19s.

Landbouwvliegtuigen, by Hugo Hooftman. N. V. Uitgeverij "De Kern," Hoofdkantoor, Amsterdam, Holland.

Zweefvliegtuigen, by Hugo Hooftman. N. V. Uitgeverij "De Kern," Hoofdkantoor, Amsterdam, Holland.

Report on the Helicopter, by Samuel C. Williams. Brundage Story and Rose, New York. Price $2.50.

Against the Wind, by Cyril Rofe. Hodder and Stoughton, Ltd., Warwick Square, London, E.C.4. Price 16s.

Rocket, by Air Chief Marshal Sir Philip Joubert de la Ferte. Hutchinson and Co. (Publishers), Ltd., 178-202, Great Portland Street, London, W.1. Price 18s.

Collected Works of Theodore von Karman, Vols. I-IV. Butterworths Scientific Publications, 4 and 5, Bell Yard, Temple Bar, London, W.C.2. Price £14 10s.

Contemporary Physics, by C. F. von Weizsacker and J. Juilfs. Hutchinson's Scientific and Technical Publications, 178-202, Great Portland Street, London, W.1. Price 18s.

"The Aeroplane" Pictorial Review, Temple Press Ltd., Bowling Green Lane, London, E.C.1. Price 7s 6d.

The Observer's Book of Aircraft, by William Green and Gerald Pollinger. Frederick Warne and Co., Ltd., Chandos House, Bedford Court, Bedford Street, London, W.C.2. Price 5s.

Doctors in the Air, by W/C. Robert Maycock. George Allen and Unwin, Ltd., Ruskin House, 40 Museum Street, London, W.C.1. Price 15s.

Viscount 802

Higher Capacity and True Operational Flexibility for Shorter Stage-lengths

A longer Viscount for shorter stage-lengths: B.E.A.'s versatile and shapely 802 started in service last Monday.

"Flight" photograph

THE introduction last Monday of the Viscount 802 into regular service with British European Airways brings fulfilment to the Corporation's plans—conceived over four years ago and announced in February 1953—for a "stretched" version of the Viscount 701. At that time the 700-series aircraft were still some weeks away from airline service, and it is interesting to recall the factors from which stemmed the decision to proceed with a greater-capacity Viscount.

In the best-regulated families airframe and engine development go hand in hand. Even before B.E.A. had taken delivery of their first Viscount higher powers were offered from Rolls-Royce (Dart RDa.5s in place of Dart RDa.3s) for a larger aircraft. The new 801 Viscount was intended to fly on B.E.A.'s high-density routes to Belfast, Edinburgh, Glasgow, Paris, Amsterdam, Brussels, Dusseldorf, Zurich, Geneva, Nice and Milan; emphasis was on the short hauls. And although in the gestation period the design departed considerably from the first tentative proposals (which envisaged a fuselage stretch of 160in), the need remained for a version with more seats and more capacity to be used on shorter stages, such as those flown at that time by B.E.A.'s piston-engined Ambassador fleet. Nor are the requirements of a complementary aircraft developed to operate on shorter stage-lengths peculiar to B.E.A.; many other of Vickers' customers could expect to benefit from additional capacity in an airframe with which they were already familiar. The Viscount 802, which was first described in *Flight* for October 22, 1954, is 46in longer overall and 111in longer in the cabin, and, in comparison with B.E.A.'s Viscount 701s, there are three additional rows of seats, a total of 57. For freight transport the shorter-stage length aircraft also has folding seats, a strengthened floor and a wide rectangular loading door.

Typical of the application of the system of paired Viscounts to other airlines is the case of Aer Lingus, who have ordered three Viscounts 808s to complement their four 707s. The 808s will be equipped with 65 seats for high-density operations between Dublin and London and the 707s could be released for development of the Irish line's longer stages from, say, Dublin to Amsterdam.

On the other hand, so popular has the Viscount proved, that it has been found entirely possible to operate the 700 profitably over quite short stage-lengths, as Capital Airlines are doing between (for example) Pittsburgh and Detroit and New York to Buffalo. Nevertheless the 700 and 800 are different aircraft designed to operate over distinctly different sectors, a factor which has been emphasized by some shuffling of orders—operators with 700s adding 800s to their fleet and other operators who originally chose 800s reverting to orders for 700s for the longer of their medium hauls.

Before the Viscount 800 reached fruition, Rolls-Royce had again increased the power of the Dart, so that—like the later 700-series aircraft—the 802 is powered by RDa.6 Mk 510s with Rotol "parallel-plan-form" propellers. The gain in take-off power over the 701—to 1,780 e.h.p. from each engine—is 13 per cent.

It is unfortunate that the term "flexibility" has deteriorated into the jargon of brochuremanship, because true operational flexibility is a feature which this latest Viscount to enter service displays to an admirable and much greater degree than have any of its predecessors. When the Corporation's Viscount 802 passenger service began on February 18 an all-freight 802 service from Milan to London had already started and the pattern of B.E.A. operations with their new equipment—which caters for easy conversion of the all-first-class interior of an outward-bound service to the mundane utility of an air freighter for the overnight return—was taking shape.

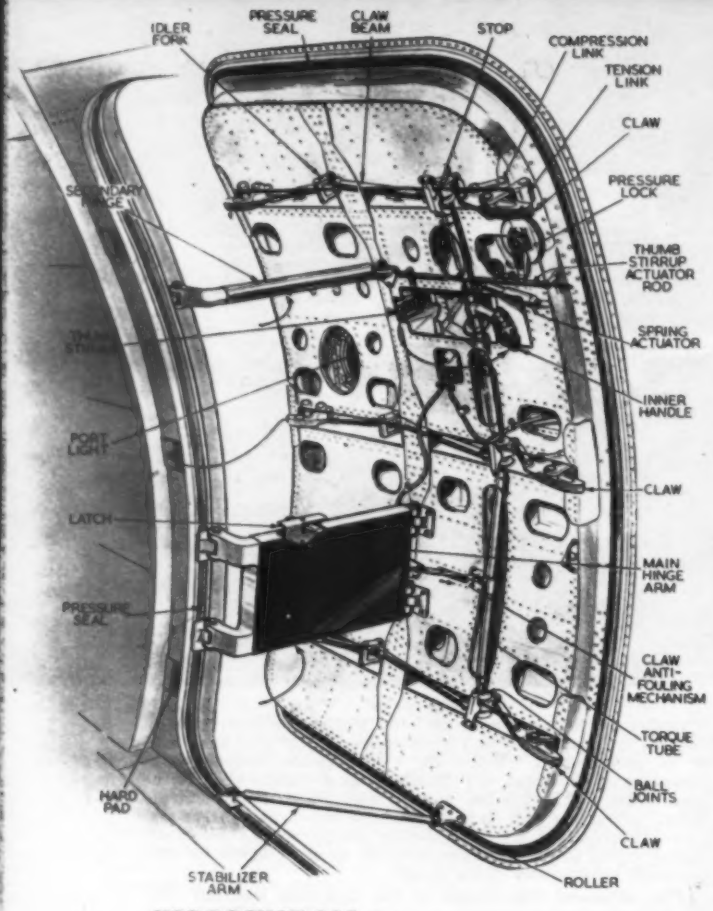
The additional 46in length of the capacious Viscount 800 has been obtained by splicing a section into the parallel portion of the fuselage and moving the pressure bulkhead 65in further aft; in this way a centre-of-gravity shift was avoided. Redesigned doors and door sills and a strengthened all-metal floor stressed for freight loadings up to 150 lb/sq ft involved Vickers in fairly major fuselage modifications; and, as production was in any case being extended, it was decided to retool all the fuselage frames. This enabled a clean design of the floor attachment and pressure bulkhead pick-up frames to be made and avoided the repetition of reinforcement modifications during production. Other tooling changes were then made to the fuselage assembly jigs; the 800 is built up on an internal tool with unrestricted access to the exterior skin panels, whereas the 700s were built in a cradle-type fixture.

All the interior fittings pick up on the flush seat-rails, the seats fold up against the cabin wall when required and the bulkheads are movable, so that layout changes to mixed-class seating or a passenger/freighter combination can be quickly made.

The folding Short and Harland seat design was chosen by B.E.A. after specifications had been submitted to no fewer than 30 firms—a reflection of the very strong competition which exists in this field. Development of the prototype seats has reduced the weight of the units—which are stressed to the A.R.B. "fore or aft facing" 9g requirement—by 340 lb (the weight of two passengers) for the complete aircraft. The seats are folded by raising the central arm-rest, removing the inboard leg from the seat-rail, folding it inwards to unlock the outer leg, and stowing the assembly against the fuselage wall. A small but well-considered feature of the installation is the moulded plastic inter-seat section which keeps the seat-rails clear of debris when the seat units are in the down position.

An innovation immediately apparent on external inspection of the Viscount 800s is that the freight and passenger doors are now of rectangular rather than elliptical shape, although stress-raising corners are avoided by the large radius on the doors and sills. The 4ft-wide, 5ft-high freight door has been designed to accommodate the arms of a fork-lift truck.

Pressurized doors present notoriously difficult design problems. The customary bolt-type lock becomes unpleasantly stiff to operate if any residual pressure remains in the cabin on landing; as little as 0.1 lb/sq in differential pressure can make the door practically unopenable. Icing, rigidity and door-open wind loads are further cases for the designer's careful consideration, because few things leave the passenger with a less favourable impression than a passenger door that requires a struggle to close



VISCOUNT 802 . . .

or—even more—to open again at the end of a flight.

The problem has been squarely tackled in the 800. A multi-claw jam-free mechanism (illustrated on this page) forms a geometric lock, and a large handle with a high mechanical advantage will open the door at a light touch from the daintiest stewardess. The claws move sideways and are consequently independent of the cabin pressure differential for their locking action; but, should one fail, the remaining claws are sufficient to prevent any sudden decompression. A safety lock has been provided on the opening handle to prevent accidental operation.

The most striking feature of the new doors is the out-and-back opening motion imparted by the parallel-linkage hinge. Apart from the immediately apparent advantage of a door which is untroubled by ground winds and out of the way during loading operations, the new design avoids the shortcomings of inward-opening or inward-and-upward opening doors, which restrict space within the fuselage and could hamper emergency escape.

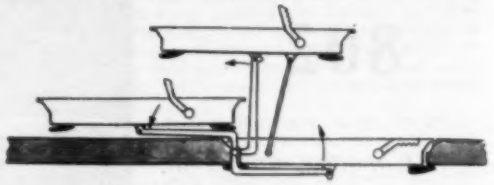
Altogether, these doors are a fine achievement; though a little more complex than those they replace, size for size they show no significant weight-penalty and should prove very satisfactory in day-to-day operation. Although reshaped, the new door still posed no special problems and follows earlier practice.

It would be unusual indeed if the half-million revenue hours of Viscount experience by operators all over the world had not suggested various ways in which the airframe and its systems could be improved; the surprise is that the modifications have been so minor. While the 802 specification lists a number of amendments that B.E.A. considered desirable from their 701 operating experience, many of these have already been incorporated in later 700-series aircraft for other customers.

Of more technical interest, however, is the change which has been made to the flap-operating mechanism. The curved guide channels (the flaps are operated by an endless chain driven from an electric-motor-actuated torque shaft) have been replaced by straight slides, the chains have been strengthened and emergency operation is now performed electrically through a pedestal-mounted switch under control of the pilot. The emergency movement is limited to 30 degrees and the flap must be reset on the ground. Previously, emergency flap-lowering required 217 turns on a handle which was mounted behind the main spar and connected directly with the flap torque-tube.

Several important changes—worked out once again with air-

The out-and-along operation of the freight and emergency exit doors (the freight door is illustrated) is controlled by a parallelogram-action linkage. Locking is effected by six claws released by an inner or outer handle via a torque tube. The advantages of the design over locking bolt arrangements are discussed in the text.



line operators and, in particular, B.E.A.—have been made to the cockpit. A number of controls have been repositioned so that all the cockpit operations may be carried out by the two pilots acting as a two-man crew—a procedure B.E.A. are adopting on their 701s. In effect, this means that, except for take-off and landing, the aircraft is flown by one man while the other acts as radio officer; the main controls are within reach of either pilot.

A seat for a radio officer or third crew-member is, however, included in the cockpit-furniture. The Flight Log of the Decca Navigator is now mounted in the coaming where it is visible to both pilots, instead of to the captain only as previously. Other flying aids in the B.E.A. layout (which will be adopted without modification by Aer Lingus and will form the basis for the cockpits of many other airlines) are Standard Telephones' V.O.R., I.L.S. and H.F. and V.H.F. radio; Marconi A.D.F.; and the Smiths Integrated Flight System with S.E.P.2 autopilot. The Viscount 802 is thus the first aircraft in service to use this British flight system. (A B.E.A. captain's appreciative comments on its efficiency appear on page 246.)

B.E.A. are to put the 802 on about a hundred services (counting flights both ways) and new routes will be opened between London and Dublin, London-Valencia, London-Belgrade, Manchester-Palma, Manchester-Barcelona, Manchester-Dublin and Birmingham-Dublin. The service which began on Monday was between London and Paris, with four out-and-home passenger services and one all-freight service a day. In April this frequency will be stepped up to eleven return passenger services and one return freight service a day.

The build-up of the fleet will continue until July. In March the London-Glasgow-Edinburgh service will begin, in April the 802 network will extend from London to Dublin, Frankfurt and Belfast; in May to Geneva; in June to Zurich and Dusseldorf and Brussels; and in July to Nice, Copenhagen and Amsterdam. By midsummer, the happy partnership of manufacturer and State operator will have but a few months to wait for the next Viscount stage—the 806, with RDa.7 Mk 520s—which will start service with the Corporation next winter. Even then, with B.E.A.'s options on seven 810s and 12 840s, there will be "more to come" for some time.

A PASSENGER'S REACTIONS

THE "800" ("802" for B.E.A.) is the handsomest member of the Viscount family. This we decided (writes the Associate Editor) on glimpsing G-AOJE *Sir Alexander Mackenzie* standing with some of her friends and relations before we boarded her at London Airport the other day. And even if handsome really *is* as handsome does, the appraisal stands, for Oscar Juliet Echo rose like a lark and settled down for Paris at 330 m.p.h. The smiles that slowly suffused the leaden morning faces of nearly three-score Pressmen soon developed as eggs, rasher, sausages, kidneys and mushrooms were served and ingested—with amazing despatch, for flight time is a mere 70 minutes. One remarked to one's neighbour (each of us lolling in a port-side, two-abreast Short seat) that either stacking or indigestion seemed to be our fate; but neither came to pass.

For the night-flight home we found ourselves as the filling of a three-abreast sandwich; and even the savour of jovial company failed to make that human sandwich (or, for that matter, the chicken dinner) wholly enjoyable. Perhaps one grows anti-social; but really this triple stacking is not for those who knew the lofty freedom of the Empire boats so many years ago. Is it quite impossible, in this big Viscount, to revert to the double-seat scheme? Would not most passengers prefer some reduction in seat-pitch to the present lateral constriction? The seats themselves are admirable; but one can have too much even of a good thing, and one's opinion that truncated seat-backs would improve visual and mental outlook was shared by others.

But perhaps we cavil. Anyway, we stepped out into the L.A.P. drizzle with glowing recollections of this big, beautiful Viscount. Not least we remembered the incomparable spaciousness and silence of the toilet.

Type	Operator	Passengers	Dart powerplant	Tanks and fuel (gall) (approx.)	All-up weight	Length ft	Length in	Remarks
701[1]	B.E.A.	47	Mk 506	1,720	60,000[2]	81	2	Except 26th and 27th aircraft, projecting cabin air intake.
702	B.W.I.A.	44/53	Mk 506	1,950	62,000	81	2	
707	Aer Lingus	53	Mk 506	1,720	60,000	81	2	Projecting cabin air intake.
708	Air France	49	Mk 505/6	1,720	60,000	81	2	Projecting cabin air intake.
720	T.A.A.	44	Mk 506	1st slipper tanks 1,950+290	62,000[9]	81	2	Supplied with slipper tank. Flush cabin air intake.
723	Indian Air Force	35	Mk 506	1,950	60,000	81	2	
724	T.C.A.	40/48	Mk 506	1,950	62,000	81	2	[3] First with 506 actually fitted at delivery. First with Maxaret brakes. Escape hatches in six windows only. Ice-guard panels in fuselage.
730	Indian A.F. V.I.P.	V.I.P.	Mk 506	1,950	60,000	81	2	
732	Hunting Clan (with Middle East Airlines)	52	Mk 506	Slipper 1,950+290	62,000[9]	81	2	[4] Square-tipped prop with Mk 506 engines.
734	Pakistan	V.I.P.	Mk 506	Slipper 1,950+290	62,000[9]	81	2	Permanently fitted slipper tanks.
735	Iraqi	44/53	Mk 506	1,950	62,000	81	2	
736	Fred Olsen	48/52	Mk 506	1,950	62,000	81	2	
737	Canadian Dept. of Transport	22	Mk 506	1,950	62,000	81	2	
739	Misrair S.A.E.	40	Mk 506	1,950	62,000	81	2	
742D	Brazil A.F.	V.I.P.	Mk 510	Slipper 1,950+290	63,000	81	2	Ex-Breathens.
744	Capital	44/48	Mk 506	1,900	60,300	81	2	Square-tipped propellers
745	Capital	44/48	Mk 506/510	1,900	60,300	81	2	Square-tipped propellers
745D								[5] 1st D aircraft delivered
747	Butler	40	Mk 506	1,950	60,000[4]	81	2	
748D	C.A.A.	47	Mk 510 D.H. props	Slipper 1,950+290	63,000	81	2	1st D order
749	L.A.V.	40	Mk 506	1,900	60,300	81	2	[4] Square-tip props with Mk 506 engines.
754D	B.O.A.C. (Middle East)	44/48	Mk 510	Slipper 1,950+290	63,000	81	10	Radar provision.
755D	Cubana	46	Mk 510	Slipper 1,950+290	63,000	81	2	Ex-Airwork.
756D	T.A.A.	44	Mk 510	Slipper 1,950+290	63,000	81	2	
757	T.C.A.	44	Mk 506	1,950	62,000	81	2	
759D	Hunting Clan	53	Mk 510	Slipper 1,950+290	63,000	81	2	
760D	Hong Kong	40/44	Mk 510	Slipper 1,950+290	63,000	81	2	
761D	U.B.A.	48	Mk 510	1,950	63,000	81	2	
763D	Hughes Tool Co.	48	Mk 510	1,900	60,300	81	2	
764D	U.S. Steel	Executive	Mk 510	Slipper + belly 1,900+290 + 450	63,000	81	10	Fuel jettisoning. Airsteps. Radar provision.
765D	Standard Oil	Executive	Mk 510	Slipper + belly 1,900+290 + 450	63,000	81	10	Fuel jettisoning. Airsteps. Radar provision.
768D	Indian Airlines	44	Mk 510	1,950	63,000	81	2	
769D	PLUNA	48	Mk 510	Slipper 1,900+290	63,000	81	10	Weather radar installed Fuel jettisoning.
772	B.O.A.C.-B.W.I.A.	48	Mk 506	1,950	62,000	81	10	Radar provision.
773	Iraqi Airways	44	Mk 506	1,950	62,000	81	2	
779D	Fred Olsen	48	Mk 510	1,900	63,000	81	10	Radar provision
781D	S. African A.F.	V.I.P.	Mk 510	Slipper 1,950+290	63,000	81	10	Weather radar installed.
782D	Iranian Government	48 or V.I.P.	Mk 510	1,950	63,000	81	10	Radar provision.
784D	Philippine Air Lines	48	Mk 510	Slipper 1,900+290	63,000	81	10	Fuel jettisoning. Radar provision.
785D	L.A.I.	48	Mk 510	1,900	63,000	81	10	Radar provision.
786D	Lloyd Aero Colombiano	48	Mk 510	1,900	63,000	81	10	Radar provision.
789D	Brazil	V.I.P.	Mk 510	Slipper + belly 1,900+290 + 450	63,000	81	10	Fuel jettisoning. Weather radar installed.
802	B.E.A.	53/65	Mk 510	1,940	63,000	85	0	External changes shown refer to most 800 series aircraft.
803	K.L.M.	53/63	Mk 510	1,940	63,000	85	0	Number one port window moved forward.
804	Transair	53/65	Mk 510	1,940	63,000	85	0	Windows as 802.
806	B.E.A.	60	R.Da7 Mk 520	1,940	63,000	85	0	[8] First three stage compressor.
807	New Zealand N.A.C.	52/60	Mk 510	1,940	63,000	85	8	Windows as 802. Radar provision.
808	Aer Lingus	58/65	Mk 510	1,940	63,000	85	0	Windows as 802.
810[7]	Vickers-Armstrongs (Aircraft)	52/56	R.Da7/1 Mk 525	1,900	67,500	85	8	Fuel jettisoning. Airsteps. Trapezoidal propellers. Weather radar installed.
812	Continental	56	Mk 525	1,900	67,500	85	8	Fuel jettisoning. Weather radar installed. Airsteps.
813	S. African Airways	56	Mk 525	1,900	67,500	85	8	Radar provision.
814	Lufthansa	54/60	Mk 525	1,900	67,500	85	8	Radar provision.
815	Pakistan	51	Mk 525	Slipper 1,900+290	67,500	85	8	Radar provision.
818	Cubana	52	Mk 525	Slipper 1,900+290	67,500	85	8	Fuel jettisoning. Radar provision.
819	Niarchos	V.I.P.	Mk 525	1,900	67,500	85	8	Radar provision.

Notes.—(1) Prototype 700: originally had Dart RDa.3 Mk 505. All-up weight 48,000 lb. (2) Except for first nine aircraft. (3) Equipment largely to North American requirements (see Note 5). (4) Square-tipped propellers and bulged cowlings were generally introduced with Dart Mk 510 powerplants. (5) Fully-Americanized aircraft: complies with special C.A.A. rules for Viscounts. When fuel jettisoning installed, a.u.w. 63,000 lb. Airsteps eventually on all 745 and 745D machines. Some with weather radar (length then 81ft 10in). This basic aircraft is supplied to some other customers. (6) First aircraft only. (7) Viscount 840 will have identical structure, but is powered with four RDa.11 Mk 541 engines. (8) Port windows as K.L.M. Two starboard windows moved one bay forward. (9) When slipper tanks are fitted weight is 63,000 lb.

701

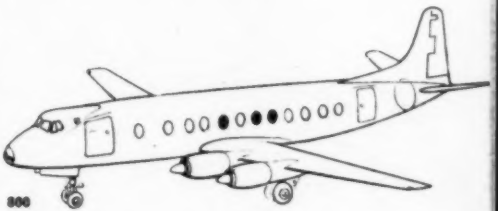
VISCOUNT VARIANTS

Vickers' policy of adapting the Viscount to meet the requirements of its customers has sold many aircraft but has resulted in a perplexing number of variants. This aide-memoire lists the main features of the aircraft supplied to each customer and shows pictorially the stage at which certain external modifications have been introduced. Apart from the prototype (630) basic series numbers are 700, 700D, 800, 810–840, but customer's special requirements result in an overlapping of external features. Escape-hatch windows are in solid black.

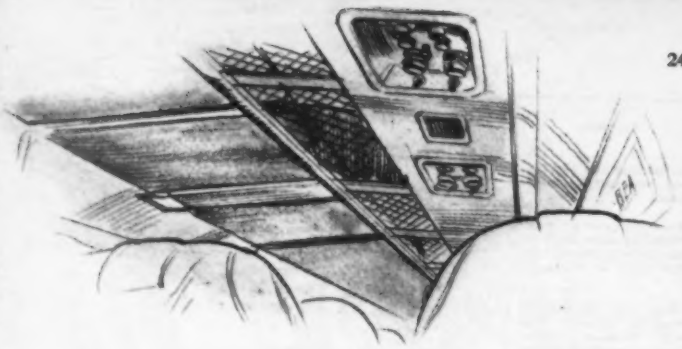
720

724

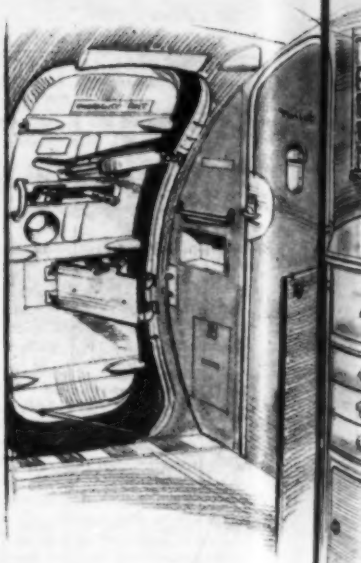
745D

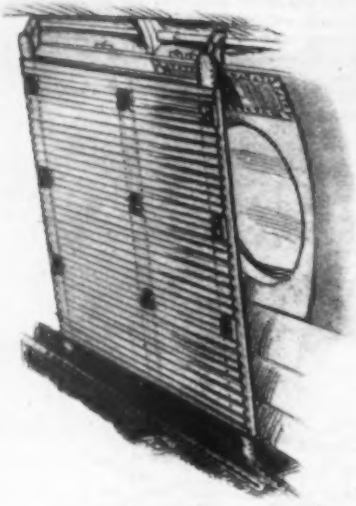

800

810
840



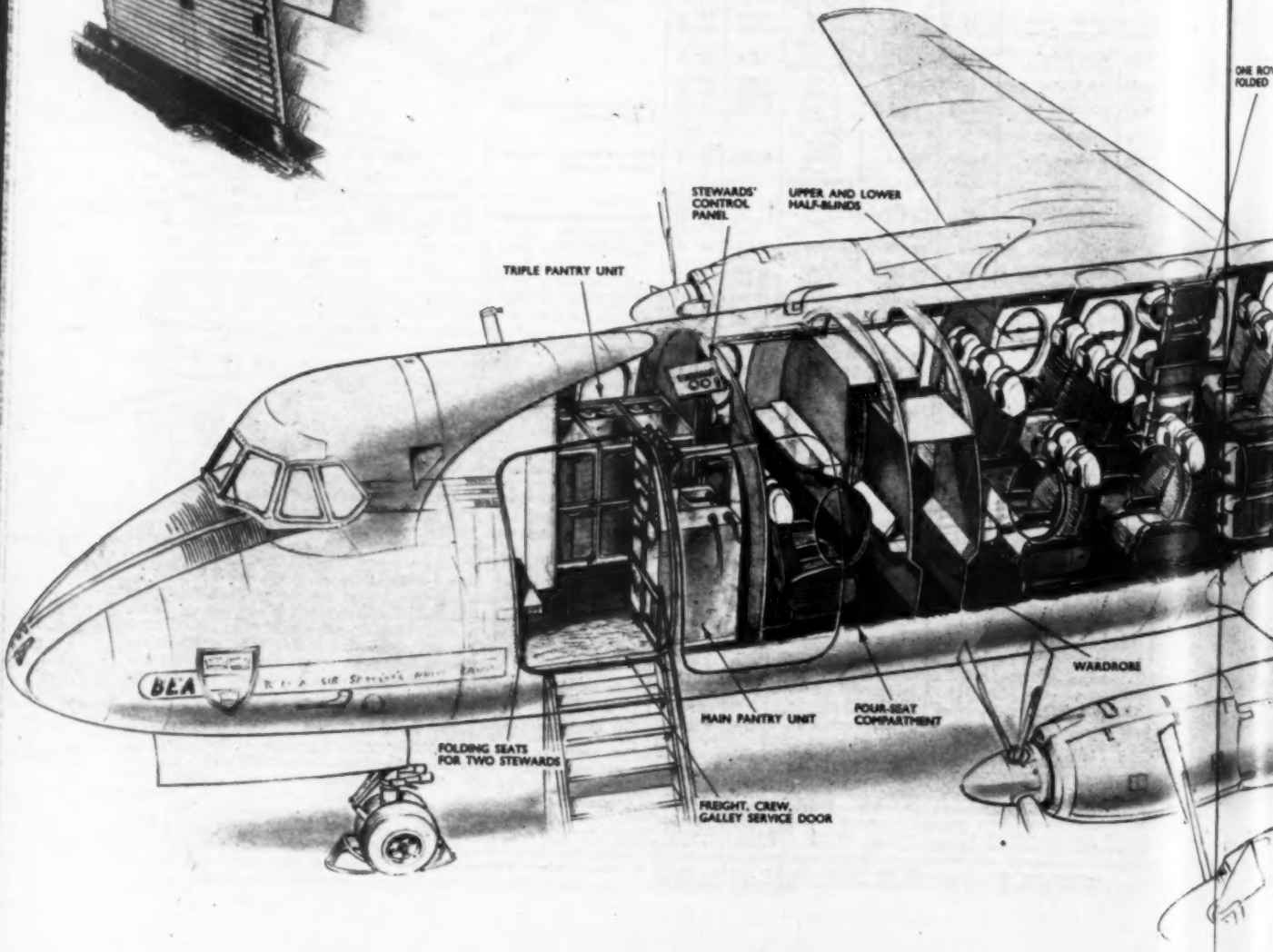
Passenger service panels and public-address loud-speakers are mounted in the overhead racks. The usable cabin width has been increased by 4in in the Viscount 802, but an illusion of even greater beam dimensions has been created by six semi-bulk-heads and by the use of transverse lighting strips in the flat Vynide-covered roof panels.





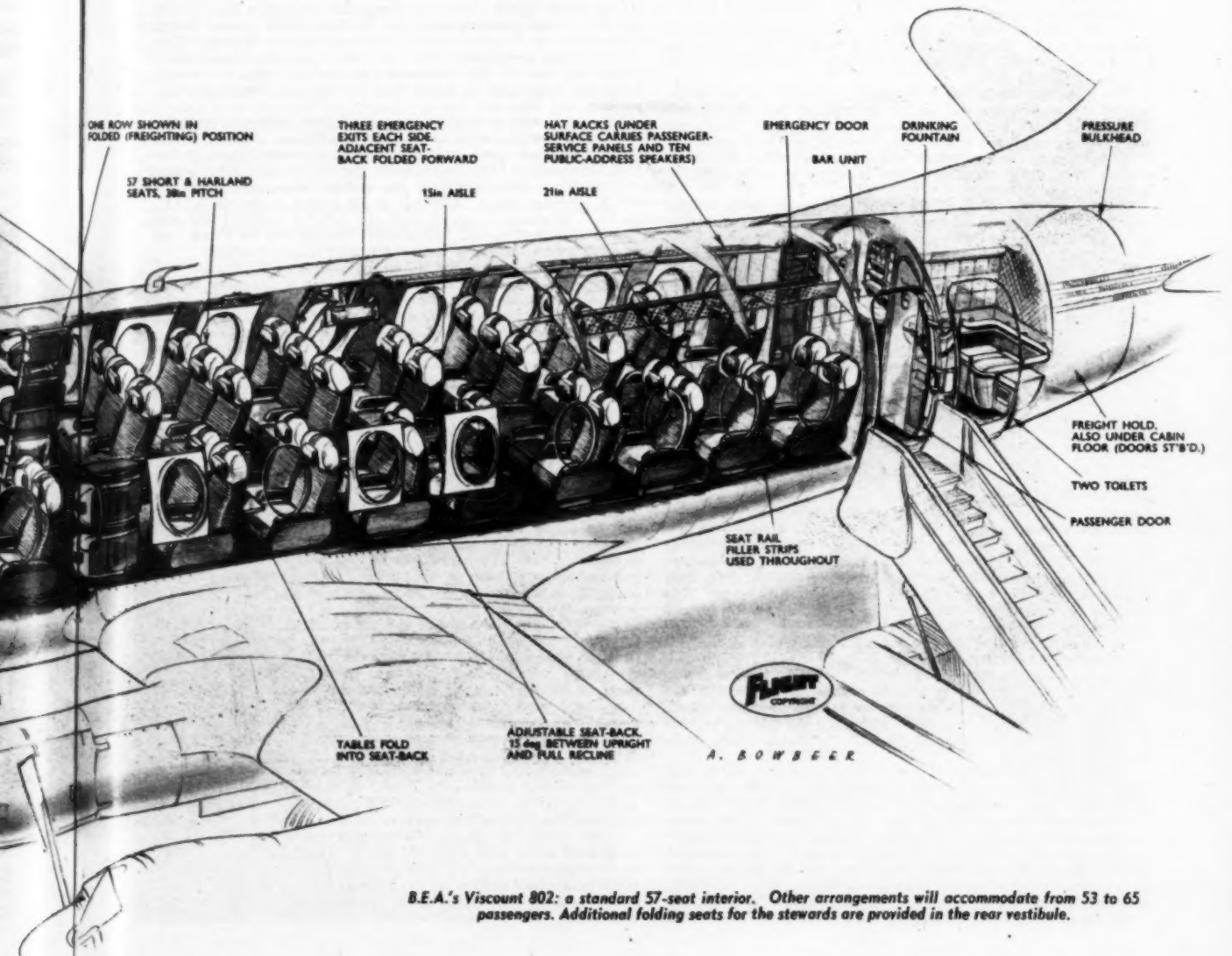
When the seats are removed to obtain maximum capacity from the 802 in its freighter rôle, these corrugated screens are used to protect the cabin lining. They are attached at the bottom to the outer seat rails and at the top to a tube normally concealed by the hat racks.

VISCOUNT 802 ACCOMMODATION



A unique feature of the B.E.A. layout is the bar unit in the passenger vestibule. The full-sized emergency exit door (a principle diagram appears on page 242) is shown partly open.

Segmented mirrors add to the spacious effect of the two commodious rear toilets. Strip lighting, quilted bulkhead facings, copper anodising on the basin and surrounds, and pink and grey wall covering add an attractive appearance to the functional design.


ONE ROW SHOWN IN FOLDED (FREIGHTING) POSITION
57 SHORT & HARLAND SEATS, 38in PITCH
THREE EMERGENCY EXITS EACH SIDE. ADJACENT SEAT-BACK FOLDED FORWARD
15in AISLE
HAT RACKS (UNDER SURFACE CARRIES PASSENGER-SERVICE PANELS AND TEN PUBLIC-ADDRESS SPEAKERS)
21in AISLE
EMERGENCY DOOR
BAR UNIT
DRINKING FOUNTAIN
PRESSURE BULKHEAD
FREIGHT HOLD, ALSO UNDER CABIN FLOOR (DOORS ST'B'D.)
TWO TOILETS
PASSENGER DOOR
SEAT RAIL FILLER STRIPS USED THROUGHOUT
TABLES FOLD INTO SEAT-BACK
ADJUSTABLE SEAT-BACK, 15 deg BETWEEN UPRIGHT AND FULL RECLINE
FLIGHT COPYRIGHT
A. BOWDLER

B.E.A.'s Viscount 802: a standard 57-seat interior. Other arrangements will accommodate from 53 to 65 passengers. Additional folding seats for the stewards are provided in the rear vestibule.

PUSH-BUTTON PILOTAGE

A Viscount Captain's Opinion of the 802 and its Flying Aids

THERE is an old saying that people who keep dogs grow to look like them. A visit to any important dog-show will prove the truth or otherwise of this contention; and my own observations lead me to think there may be something in it.

Following the same train of thought on aircraft, the observer will discover that B.E.A. name their aircraft classes Pionair, Elizabethan and Discovery. The names of the individual aircraft with each class are those of men who were looking, in the broad sense, for something new; and in each of these aircraft types there has been something new.

The question therefore arises, rather in the manner of the chicken and the egg—which came first, the aircraft or the class name? And have B.E.A. become so infused with the spirit of the historic figures whose names their machines carry that each new type will be pioneering some new piece of equipment, engine, layout, or what have you?

It would, indeed, appear that this is the case—the DC-3 was "retailored" both in the cockpit and cabin; the Viking and Elizabethan were both new types with their own special features; the Viscount 701 was the first turboprop airliner and the new Viscount 802, or Viscount Major as some people call it, has features which both outwardly and inwardly distinguish it from its elder sister the 701; and it is doing a pioneering job, this time on new flight systems.

To the casual observer there is little outward difference between the two Viscounts, although I consider the 802 to be better proportioned. It is inside the passenger and control cabins that the difference lies.

The passenger cabin has new-type seats which can be folded against the walls when the aircraft is required to carry freight. The ceiling is flat instead of curved, thus effectively preventing any tube-like impression; and when 57 seats are fitted there is a separate compartment with four seats—two each side—which has already been aptly christened "the snogging compartment, or honeymooners' delight."

Moving forward through the galley (complete with fridge) into the control cabin one finds little resemblance to that of the 701. Designed some two years ago on the basis of a two-pilot crew, to take advantage of the new aids forecast to be in operation when the aircraft was to go into service, the layout offers switch panels that have been moved to better positions, generator switches and ammeters moved to positions accessible to the first officer, and essential items needed in feathering and fire drill grouped together in the "drill order" and accessible to both pilots.

Navigational aids consist of Decca Mk 7A (pending arrival of the Mk 10), V.O.R. and A.D.F. receivers. Communications are carried out by means of two V.H.F. sets and one H.F. set—which can also be used by a radio officer, if required, over longer routes. These items, of course, are not particularly new. The fresh outlook arrives in the shape of automatic engine synchronizer, the Smiths Flight System, and the S.E.P.2 autopilot with height lock and coupled or automatic approach.

Flying the 802 after the 701 presents no difficulty. The ailerons are slightly more positive and the rudder somewhat lighter. The extra distance ahead of the engines makes no difference except, perhaps, to lower the noise level. The first thing which strikes the "new boy" is when the climbing power of 13,600 r.p.m. is set and the autosynchronizer for the engines switched in; immediately the "who hum" of slightly differently phased engines dies away and only a steady hum is heard. This is especially noticeable in the passenger cabin and to all intents considerably reduces the noise level.

On reaching cruising altitude the S.E.P.2 autopilot is engaged (if it has not already been used on the climb), and the height-lock button pulled out to engage. This is an incredible device, and to watch it keeping the 802 at plus or minus 50ft of the selected altitude is uncanny. All Viscounts are sensitive to fore-and-aft movements of people in the cabin, and when the staff are serving a meal it really works overtime, moving the elevator trim backwards and forwards.

Meanwhile the captain will have been selecting the V.O.R. radial he desires to use on the omni-bearing selector, and also setting this up on the beam compass of the Smiths Flight System. This operation completed and the "sense" knob in its correct position, all that remains to be done is to pull the "beam" switch on the autopilot and the 802 will settle on to the selected radial, maintaining its selected height and course, leaving the two pilots to get on with the mundane tasks of communications, keeping a look-out, checking fuel states, obtaining weather forecasts, etc.

All the time the autopilot is flying the 802 the captain has visual evidence of what is going on in relation to the track selected. The V.O.R. (or I.L.S.) signal selected is fed into the localizer bar in the beam compass, and this moves left or right across the compass face. As the heading pointer always shows the aircraft's heading and has a small aeroplane in the centre, the "picture" will show whether the 802 is flying along, towards or away from the selected radial or I.L.S. locator beam.

Again, alteration from one V.O.R. radial to another is simplicity itself. The "sense" knob is turned to uncouple the V.O.R. signals, the 802 meanwhile continuing to fly on the previously selected heading. The new V.O.R. is tuned in and the required radial selected on the omni-bearing selector, the "beam" switch is pushed out, and the new radial set up on the beam compass. (If the beam switch is not out during this operation the aircraft will follow the movement of the heading index on the beam compass!) All is now ready to recouple to the V.O.R. The "sense" knob is retuned to the appropriate position, beam switch pulled on, and the 802 turns and subsides on to the new track, while its behaviour is being watched on the beam-compass picture.

Of course, this procedure can be adopted only where there are V.O.R. stations sited in suitable positions in relation to the track to be made good, and this situation does not obtain in the U.K., the only V.O.R. (apart from that of the U.S.A.F.) being at Strumble—which is of little use, except for cross bearings, on B.E.A. internal routes. One has to use Decca or the old A.D.F. on M.F. beacons. Even so, with the S.E.P.2 engaged and the "beam" switched to ON, the aircraft heading can be altered by merely turning the index knob to the appropriate heading.

This method of flying the 802 on the Smiths Flight System and S.E.P.2 may sound a trifle complicated, but it has been found that pilots coming on to the system from Viscount 701s have taken less time than was at first envisaged to become accustomed to the new presentation; and, without exception, they like it.

Sooner or later, however, one has to leave the eight-eighths "blue" and begin the let-down, probably finishing with an I.L.S. Here again the Smiths Flight System assists in no mean manner, either on a manual approach or, in particular, on automatic. The automatic approach is really fascinating. Assuming that the aircraft has reached the holding pattern and has been cleared to approach, and the particular I.L.S. has been selected and identified, the QDM of the runway is set to the top of the beam compass, the "sense" knob turned to the appropriate position, and the glide-path knob wound down. The two pilots then have a picture on the beam compass as to the relationship of the aircraft to the localizer beam, and the angle of attack, if any; the pitch pointer on the director horizon gives the relationship to the glide-path. On an automatic approach the S.E.P.2 is then engaged and the beam switch pulled. The aircraft will then fly along the beam, or attack at an angle which will vary depending on its lateral distance from the beam.

When the glide-path needle moves into the circle of the miniature aeroplane on the director horizon, the height-lock switch (if it has been used for holding the pattern) is pushed off and the glide-path switch pulled on. Thus the 802 is then coupled to both the localizer and the glide-path, and all the pilot has to do is to lower any appropriate amount of flap and reduce power to keep the airspeed as desired. The autopilot automatically trims the aircraft to a neutral position; and having laid off the necessary drift for the surface wind on the heading index, the pilot can monitor the whole let-down on the altimeter, airspeed indicator and the beam-compass picture until he reaches break-off height, at which point pushing a button on the control column disengages the autopilot, leaving him with his aircraft trimmed for landing.

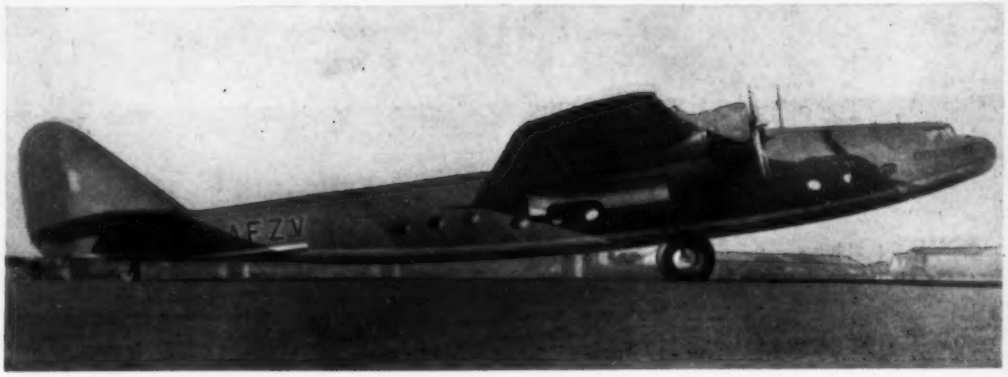
Such is life on the 802—down the centre line and on the glide-path every time without fail. If there is drift, the picture on the beam compass will show the aircraft "crabbing" down the beam and where to look for the runway.

No wonder one captain, after completing his first training detail, said "It's a honey!"

G. T. G.

CAPT. GEOFFREY T. GREENHALGH, the author of this specially contributed article, is Flight Manager, B.E.A. V.802 Flight. He was a pilot with Blackpool and West Coast Air Services and opened up that company's services to the Isle of Man, Belfast, Carlisle and Glasgow in pre-war years. During the war he served as a civil communications pilot and later became chief pilot of Associated Airways Joint Committee. In 1946 he joined B.E.A. and was in turn appointed Flight Captain of its Liverpool Flight, No. 1 Viking Flight and Pionair Flight. Over two years ago he was assigned special duties in preparation for the introduction of the Viscount 800.

"Enterprise" at Hamble before her first flight, made in 1941.



ENSIGN CLASS

By PETER W. MOSS

The History of a Fleet of Airliners That Went to War

Part II

AS the existing engines were not proving satisfactory under service conditions, a decision was taken to re-equip the surviving eight Ensigns with Wright Cyclone G.102As. This new source of power gave the Ensigns a better overall performance, but still not enough to give them maximum efficiency. Because of this change the designation became A.W.27 Mk 2—not A.W.27a, which is believed to have been allotted to a rail-launching project to Specification 13/38.

It will be remembered that Imperial Airways had ordered a further two Ensigns in December 1936, but with the intervention of war the order was cancelled and work on them ceased while they were only partially completed. It was not until late 1940 that Ensign completion became top priority and work was recommenced. Suitable modifications were made to bring the aircraft up to latest requirements and *Everest* became the prototype Mk 2. Although registrations following on from G-ADTC were originally allotted they were later cancelled and reallocated as follows:—

Works No.	Registrations	Fleet Name	First Flew	C. of A. No.	Issued
AW.1821	G-AFZU ex G-ADTE	*Everest*	20. 6.41	6886	26.6.41
AW.1822	G-AFZV ex G-ADTD	*Enterprise*	28.10.41	6912	1.11.41

Down on the desert near Dakar—"Enterprise" photographed from the 204 Sqn. Sunderland which took off her crew from a nearby beach.

First flown on June 20, 1941, *Everest* was test-flown on June 24, loaded as for delivery, by Eric Greenwood. He rejected her because of instrument trouble, but this was corrected and delivery to Bramcote was made later the same day. *Enterprise*, emerging from the flight shop four months later, made her first test flight in the hands of Eric Greenwood (this was the only Ensign not taken up by Turner-Hughes on the maiden flight) and was delivered to Bramcote on October 30.

During the repair of *Euterpe* she was modified to Mk 2 standard and first flown in this form at Hamble on July 8, 1942, in the hands of Mr. Greenwood, with a further test flight on the 11th before delivery to Bramcote the same day.

The year 1941 introduced a standardized camouflage scheme for Ensigns, consisting of dark-earth and dark-green upper surfaces and fuselage sides, with undersurfaces painted silver. Registration letters were in black with a thin silver (or gold) outline and underlined with red, white and blue stripes, each 6in wide. Vertical red, white and blue stripes were painted on the trailing edge of the fin, each stripe being 8in wide and 27in high. R.A.F. roundels and rudder stripes were deleted, but fleet names were reintroduced for the first time since the aircraft had received their war paint.

As fast as B.O.A.C. could convert Ensigns at Bramcote, they were flown out to the Middle East. Redistribution flights started towards the end of 1941, and the last machine reached Cairo early in 1943, when Captain V. E. Flowerday* piloted *Egeria* on her 5,000-mile journey. Although the best part of the operation went smoothly, it was not without its dangers and material loss.

About a year earlier, on November 9, 1941, Captain Flowerday took *Everest* to Portreath, in Cornwall, for a delivery flight to Cairo *via* Lisbon - Gibraltar - Malta. Approximately one hour and twenty minutes after leaving Portreath, while flying over the Bay of Biscay, *Everest* was viciously attacked by a marauding Heinkel He 111 that approached unseen from astern and fired three bursts of machine-gun fire into the starboard wing before turning to port and passing in front of *Everest* at close quarters. To avoid fire from the Heinkel's rear gunner, Flowerday banked the Ensign steeply to starboard and dived from 5,800ft to cloud cover; but, as this was too thin, he continued to within 20ft of the sea, reaching a speed of 340 m.p.h. in doing so!

Returning to Portreath, he found that the starboard undercarriage and wing had been damaged and that the front pane of the windscreen had been shattered by air pressure. Both hydraulic pressure-pipe lines on the starboard undercarriage were fractured, while No. 7 vertical member in the starboard wing was damaged, as were both Dowty pumps. The damaged machine was later flown into Bramcote and, when repairs were completed, she was taken to Cairo without further incident.

If the above experience was discouraging, the loss of *Enterprise* three months later must have been a grave blow for B.O.A.C. The aircraft was delivered from Bramcote to Portreath on the first stage of a delivery flight to Bathurst, in Gambia. Commanded by Captain W. B. Houston,† she left Portreath on February 1, 1942, and arrived at Gibraltar the same day. In addition to the normal 1,064 gallons of fuel carried, two tanks were lashed to the fuselage floor, making a total tankage of 2,074 gallons. [*Contd. overleaf*

**Captain Flowerday had been appointed O.B.E. in 1938 after piloting Mr. Neville Chamberlain to Munich in the British Airways Electra G-AERP, during the crisis week of September 1938. He had also inaugurated the first British foreign night-mail service in 1938.*

†His name will be familiar to our readers as the author of an article on the Bristol Britannia, in "Flight" three weeks ago.—Ed.

"Egeria" landing at Khartoum in 1944. There are still faint signs of the Union Jack which was painted on the fuselage just aft of the flight deck and later painted out.

ENSIGN CLASS . . .

Gibraltar was left at 3.18 a.m. on the 3rd and the flight to Bathurst was uneventful until about 12.15 a.m., when the port inner Cyclone began to overheat and loss of oil became abnormal; yet when more oil was poured into the engine it became unmanageable, and had to be stopped and the airscrew feathered. Later, the port outer Cyclone also began to run roughly and Captain Houston decided that it would be wiser to fly nearer land; altering course, he reached the coast of French West Africa at approximately 1,000ft, but they were losing height at the rate of 100ft/min. He flew on for a while in the hope of finding a suitable place to land, as it was obviously impossible to reach Bathurst, some 300 miles away. A flat expanse of sandy desert was sighted about a mile inland and, as the Ensign circled, Captain Houston decided it was suitable and made a smooth belly-landing within 85 yards of touch-down.

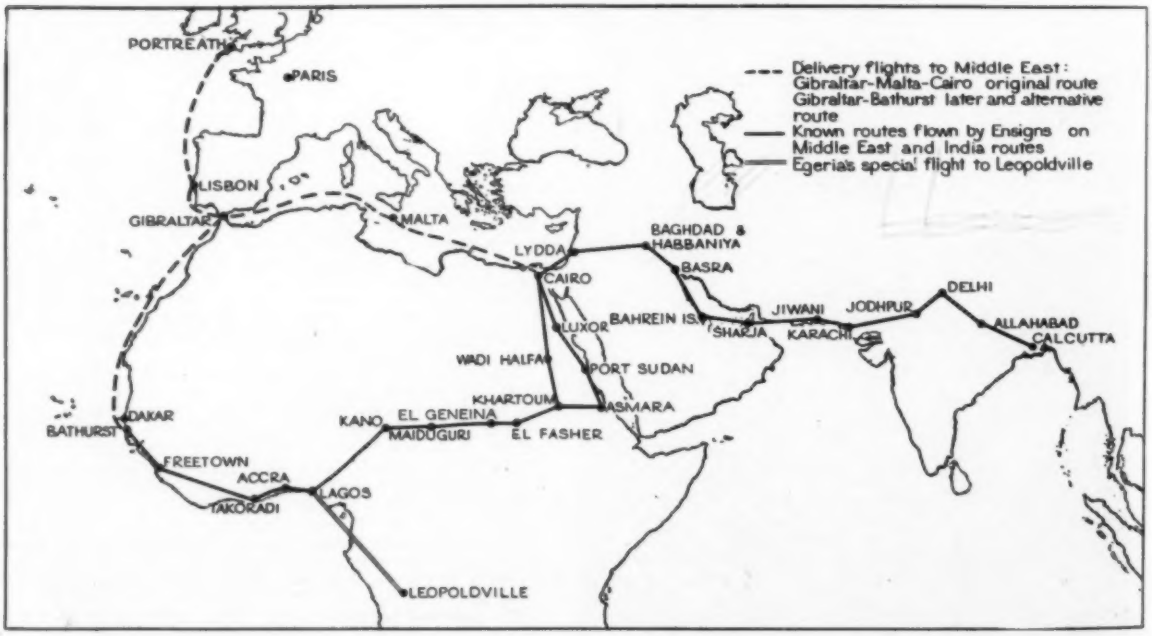
The immediate reaction was to burn all codes and secret papers except those indicating that the crew were civilians. The "Cyko" machine (for decoding signals) was smashed and buried in the sand. An examination of the Ensign revealed slight buckling of the bulkhead, with some distortion amidships, and the entrance door had to be forced open. It was decided that Bathurst should be contacted and the two-stroke generating engine was started up with difficulty; but the radio officer was able to make contact in clear, giving their position as 018° 30'N, 016° 02'W, near Cape Mirik and a town called Ouagshott in Mauritania. They received a coded reply informing them that a Sunderland would be sent to find them; but, of course, they were now unable to decode the message—so when the Sunderland (of No. 204 Sqn.), piloted by F/L. E. M. Ennis, eventually arrived and circled overhead, they were greatly relieved. A message "Go to beach" was flashed to the Ensign crew by signal lamp, and when they arrived two dinghies were sent off from the Sunderland, which had anchored about 300 yards off-shore. A fairly heavy sea made the transfer none too easy, and all luggage had to be left behind. In almost complete darkness they took off and arrived safely at Bathurst a few hours later.

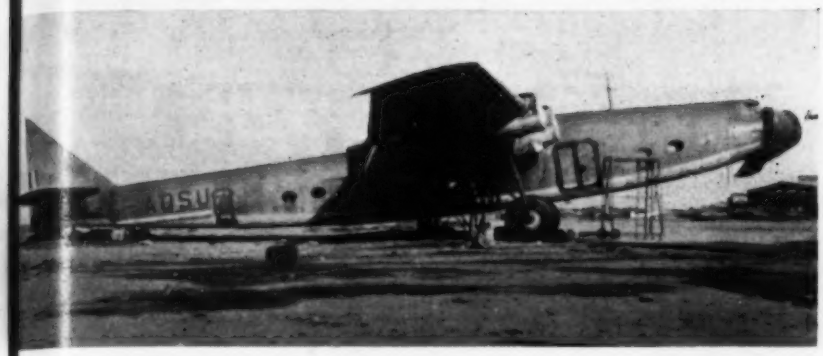
Unlike her crew, *Enterprise* had to be abandoned. French mechanics at Ouagshott and Dakar found very little difficulty in repairing the Ensign, and she served the French as a hospital aircraft at Dakar before MM. Foulachier and Melerard of Air France flew her over to Vichy France. In 1942 they delivered the aircraft to the Centre d'Etudes en Vol du Ministère de l'Air at Marignane, for general inspection and flying trials. Their test pilot, M. Edward Bret, flew her in November of that year and, although he did not complete all flying tests before the German occupation of Vichy France, he reported *Enterprise* very pleasant to fly and without vice. Eventually she was returned to Air France for their own use; but the Germans thought otherwise, and the aircraft became the property of the *Reichsluftfahrtministerium*. Like *Ettrick*, *Enterprise* was re-engined with Daimler-Benz motors and extensively test flown before taking up duties as a transport for senior officers. Good reports on the performance of the re-engined Ensigns were given by test pilots and the R.L.M. technical staff.*

It is believed that G-AFZV *Enterprise* received the registration F-BAMO before falling into German hands, but until photographic evidence is unearthed, this marking cannot be taken seriously. F-BAMO was, in fact, used by an A.A.C.-1 (French built Ju 52/3m) before the present craze for re-allocations was adopted. A P.R.U. photograph on page 281, Vol. 2, of *Evidence in Camera*

* *Can any reader throw light on the markings, performance and ultimate fates of these two Ensigns?*

The principal routes over which the Ensigns flew on their war-time duties between 1941 and 1945.





"Euterpe" in process of being cannibalized to provide components for the reconditioning of her sister aircraft before their return from the Middle East.

(Below) "Eddystone" after a belly-landing at Castel Benito on New Year's Day of 1946.

shows an Ensign on Toulouse-Montaudiron Aerodrome during the winter of 1942-43, but the French markings are not distinct.

B.O.A.C. employed their nine remaining Ensigns on ferrying Service personnel and cargo between East African ports, Khartoum, Cairo and West African ports —their passengers having to recline on mattresses, as all seats had been removed. After 1943 the aircraft were based at Almaza (Cairo), Karachi, Lagos and Asmara; then, in 1944, they were used on the Cairo-Calcutta route (see map), until their withdrawal in 1945. At least one special flight was made when *Egeria*, with a large Union Jack painted on the fuselage just aft of the cockpit windows, was flown direct from Lagos to Leopoldville, in the Belgian Congo, to deliver a spare engine for the Empire flying-boat G-ADUV *Cambria*. Inevitably, and like all types of aircraft Ensigns had their moments of trouble—particularly engine trouble; but other mishaps also led to their becoming temporarily unserviceable, a few of which are interesting enough to record.

While on a flight to Jodhpur from Delhi on March 22, 1944, *Ensign* came into contact with a large bird fifteen minutes after departure. On inspection at Delhi it was found that the fabric was opened up around the port tailplane and that the bird, a kite hawk, was a complete write-off. A similar experience befell *Elsinore* on October 11, 1944, during the course of a flight from Delhi, when a similar type of fowl flew into the port mainplane. Several months earlier *Elsinore* had been involved in an accident at Jiwani Airport, after a flight from Mauripur on May 27. While circling Jiwani, Captain M. W. Haddon discovered that the port undercarriage leg had become inoperative, and as he was low in fuel he decided to risk a belly-landing. This he succeeded in doing without damaging the aircraft beyond the fuselage undersurfaces.

G-ADSR *Ensign* was badly damaged on September 4, 1942, at Apapa Airfield, Lagos, when her undercarriage was accidentally retracted while on the ground. Temporary repairs were carried out and she was flown regularly until her C. of A. overhaul fell due in September 1944. But when the fuselage was stripped and inspected it became apparent that the labour required to effect permanent repairs was unavailable. As a result, she was "retired" while still under C. of A. and was used as a training machine for ground engineers. Finally, with engines and undercarriage removed, the once proud Ensign was broken-up on January 3, 1945.

One interesting modification has come to light. In 1944 G-ADTB *Echo* was experimentally fitted with a Lancaster tailwheel, as replacements were becoming scarce. This had the effect of increasing the landing run, because of the reduced drag of a tail raised a further 9in when on the ground. As the modification proved successful in other respects, it is possible that other Ensigns were similarly treated.

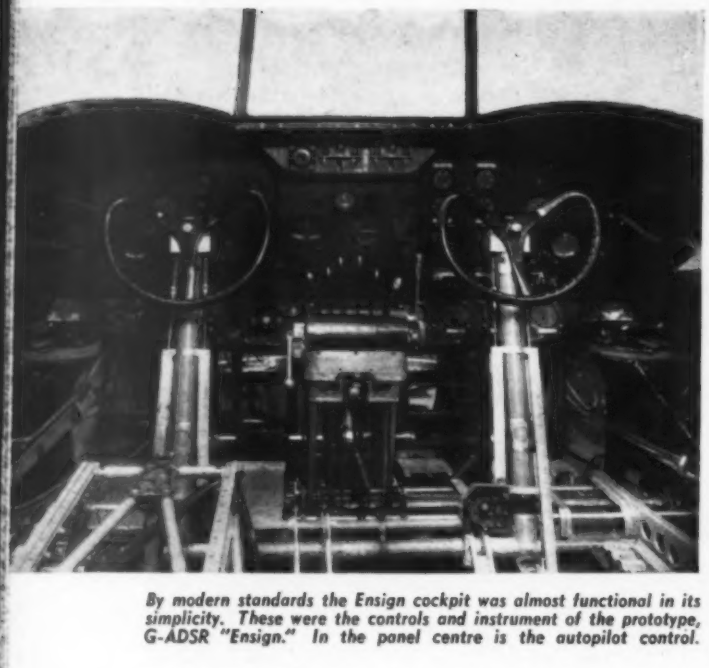
Lack of an air compressor made pilots very economical in the use of their brakes. Aileron drag worked superbly on the ground and taxying was often carried out with the tail up by using the inboard engines, while turns were made by the outboard motors and aileron drag. The brakes were used for stopping and parking only. Captain "Bill" Gregory's most vivid impression of the Ensign was of getting soaked to the skin while flying across India during the Monsoon season; as a protection against such experiences, B.O.A.C. later supplied waterproof aprons that covered their pilots from chin to rudder bars!

With the war over, Ensigns were honourably withdrawn from service, and their fate hung in the balance. Unfavourable reports on performance tended to make the official mind hesitate on this problem, and it was quite a while before a definite decision was reached. Of the faults, the poor climbing characteristics were most prominent; this was noticeable immediately after take-off and was seriously influenced by the time required for undercarriage retraction, which on an average was seventy seconds. Defects of a minor nature were found in the continual loosening of rivets holding the skin of the mainplane, probably owing to vibration. Abnormal maintenance was required to keep the fabric areas in reasonable condition, especially where it adhered to metal; this was mainly due to the intense heat and the rotting effect of the camouflage dope, with the result that during their C. of A. overhauls in 1944-45 Ensigns were stripped of wartime camouflage and left in "natural" finish.

With the official mind at last made up, orders were received in Cairo to service all Ensigns for their return flight to the U.K. To these ends G-ADSU *Euterpe* (she was by now familiarly called "you twerp") had to be sacrificed, as she was in the worst condition —having, in fact, been idle since her withdrawal from service in February 1945. She was officially written-off on February 15, 1946, but remained in existence until March 23, when she finally expired.

[*Contd. overleaf*

Last home and the last of the Ensign fleet —G-ADSW "Eddystone," broken up on April 21, 1947. This photograph was taken at Hamble a few days before the axe fell.



By modern standards the Ensign cockpit was almost functional in its simplicity. These were the controls and instrument of the prototype, G-ADSR "Ensign." In the panel centre is the autopilot control.

ENSIGN CLASS . . .

First away on a redistribution flight was G-ADSW *Eddystone*, under the command of Captain S. G. Blackaller, on January 1, 1946. The route planned was from Almaza - El Adam - Castel Benito - El Mas - Istres - Paris - Hurn. During landing preparations while circling Castel Benito airfield, Tripolitania, the same day, it was noticed that the starboard undercarriage leg refused to lock down, and all efforts to make it do so failed. Captain Blackaller was obliged to make a belly-landing which, although successful, was marred by a metalled taxying track encountered just before the aircraft stopped, causing further damage.

Later, with her undercarriage locked down and Captain T. M. Walters at the controls, *Eddystone* was flown back to Almaza for repairs on April 2, 1946, calling at Benina and El Adem on the way. Because work on the other Ensigns was all-important, *Eddystone* had to wait and nearly missed being repaired at all, through lack of skilled labour; but the last B.O.A.C. staff to leave Almaza volunteered to stay behind and attend to her. Under the command of Captain O. Pritchard, they left Cairo on June 3, flying to Hurn *via* Marseilles on the last passenger service operated by an Ensign.

Empyrean left Almaza on January 4, operating service 30M.860X, followed by *Echo* on the 29th, service 30M.894X, and *Elsinore* left on February 6, service 30M.907X. The others, G-ADSV, 'DSS and 'FZU, arrived at Hurn Airport during February, March and May respectively. As the Ensigns reached Hurn, B.O.A.C. serviced them for their last flight home to Hamble, where they were struck off charge on May 23 and taken over by Air Service Training at Hamble.

It was hoped that a customer could be found, and A.S.T. even received a contract from the M.o.S. to strip *Empyrean* down in order to assess the cost of conversion. The seven Ensigns were put up for sale at Hamble between October 14 and 18, 1946. Portsmouth Aviation and a Mr. Gisbourne of Holmwood Motors are known to have been interested in having the aircraft converted, but lost interest when confronted with the estimated cost of £162,000 for stripping all seven Ensigns to a shell only. Plans were also drawn up for 34- and 42-seater versions, but it was finally decided that the whole project would be too costly and their fate was sealed. They were flown from Hurn to Hamble, broken up and removed as follows:—

Regn.	Arrived Hamble	Broken-up and Removed	Total Time Flown	Miles Flown
			hr min	
G-ADSY	7-1-46	26-3-47	3,478 28	501,675
G-ADTB	19-2-46	20-3-47	3,534 23	507,083
G-ADST	19-2-46	28-3-47	3,495 27	492,770
G-ADSV	25-2-46	23-3-47	3,720 01	528,360
G-ADSS	20-3-46	13-4-47	2,686 26	382,707
G-AFZU	10-5-46	16-4-47	2,406 43	N.A.
G-ADSW	5-6-46	21-4-47	3,595 44	502,047

In addition, it is interesting to note that G-ADSR, up to the time of C. of A. expiry on September 17, 1944, had flown only 286,240 miles in 2099 hr 04 min; while G-ADSU covered 406,061 miles before her C. of A. expired on February 24, 1945.

All seven remnants of the great Ensign Class were removed by the Ministry in "Queen Marys" and taken to No. 1 M.P.R.D. at Cowley, Oxfordshire, where they were finally, in official parlance, reduced to produce.

Acknowledgements: The author would like to thank those who have helped in making this history possible, including Mr. Turner-Hughes; Mr. Sidwell and staff of Air Service Training; Sir W. G. Armstrong Whitworth Aircraft, Ltd.; Mr. E. S. Greenwood; B.O.A.C.; Mr. H. P. Macklin, editor of *B.O.A.C. Review*; M.T.C.A.; Air-Britain; and Capt. J. L. Gregory and other B.O.A.C. captains and crew-members.

ENSIGN LEADING DATA

A.W.27 Mk 1

Span, 123 ft; height, 33 ft over propellers; length, 114 ft; wing area, 2,450 sq ft.
Power Units: Four 790 h.p. Armstrong Siddeley Tiger 1X air-cooled radial engines; (1939) four 850 h.p. Tiger 1Xc.
Performance: Max. speed, 205 m.p.h. at 7,000 ft; cruising, 170 m.p.h. at 7,000 ft; stalling, 60 m.p.h.; landing, 64 m.p.h.
Weights: Empty, 32,920 lb; loaded, 49,000 lb. Disposable load, 9,580 lb incl. crew. Wing loading, 20 lb/sq ft. Power loading, 13.9 lb/h.p.
Range: 800 miles in still air at 62 per cent max. power.
Rate of climb: 600 ft/min at sea level.
Service ceiling: 18,000 ft fully loaded.
Tankage: Fuel, 650 Imp. gal. Oil, 40 Imp. gal.

A.W.27 Mk 2

Power units: Four 950 h.p. Wright Cyclone GR-1820-G.102A air-cooled radial engines.
Performance: Max. speed, 210 m.p.h. at 6,700 ft; cruising, 180 m.p.h. at 5,000 ft.
Weights: Empty, 36,586 lb; loaded, 55,500 lb; max., 66,000 lb. Disposable load, 12,000 lb incl. crew. Wing loading, 22.6 lb/sq ft. Power loading, 11.9 lb/h.p. at take-off.
Range: 1,370 miles at 173 m.p.h. at 5,000 ft.
Rate of climb: 900 ft/min at sea level.
Service ceiling: 24,000 ft fully loaded.
Tankage: Fuel, 1,064 Imp. gal.

FORTHCOMING EVENTS

Feb. 23. Northern Heights Model Flying Club: Dinner and Dance.
Feb. 26. R.Ae.S.: Section Lecture: "Recent Advances in the Design of Aircraft Tyres and Brakes," by H. W. Trevaskis, A.F.R.Ae.S.
Feb. 27. Kronfeld Club: "Ballooning," by W. H. Scanlon.
Mar. 2. British Interplanetary Society: "Design and Application of Solid Propellant Rocket Motors," by E. T. B. Smith, B.Sc., A.F.R.Ae.S., G.I.Mech.E.
Mar. 5. Aviation Forum: "Air Traffic Control," by S. G. Fitch.
Mar. 5. R.Ae.S.: Graduates and Students Section: A.G.M. and Film Show.
Mar. 7. R.Ae.S.: Tenth Louis Blériot Lecture: "New Methods in Aircraft Production," by M. Badré, production director of Ouest Aviation.
Mar. 8. Helicopter Association: "All Weather Operation of Helicopters—Engineering and Piloting Aspects," by P. A. Hearne, D.C.Ae., and J. W. Reid, D.F.C.
Mar. 12. R.Ae.S.: Section Lecture: "High Temperature Materials for Engines," by E. R. Gadd.
Mar. 19. R.Ae.S.: Graduates and Students Section: "Gas Turbines for Helicopters," by A. W. Morley.
Mar. 26. R.Ae.S.: Section Lecture: "Application of Automatic Digital Computers to Aeronautical Problems," by Dr. S. H. Hollingdale.
Apr. 6. British Interplanetary Society: "History of Rocket Development in the Walterwerke," by H. Walder.

May 24-June 2. Paris Aero Show, Le Bourget.
Sept. 2-8. S.B.A.C. Show, Farnborough.

R.Ae.S. Branch Fixtures (to Mar. 14)

Feb. 15, *Brough*, Annual Dinner and Dance; *Birmingham*, President's Night. Feb. 18, *Henlow*, "New Methods of Approach to Airworthiness," by W. Tve. Feb. 19, *Belfast*, Lecture on "Welding," by K. A. Peel. Feb. 20, *Bristol*, "Viscount," by B. E. Stephenson; *Brough*, "Prospects and Problems in the Use of Nuclear Energy" by Prof. G. F. J. Garlick; *London Airport*, "Independents or State Airlines," by M. H. Curtis; *Manchester* "Flying Experiences," by Capt. O. P. Jones; *Southampton*, Branch Prize Papers; *Weybridge*, "Investigation of Aircraft Accidents," by E. L. Ripley. Feb. 21, *Isle of Wight*, "Training of Aeronautical Engineers," by Prof. A. R. Collar; *Merthyr Tydfil*, "Some Lubrication Problems," by D. O. MacDougall. Feb. 25, *Glasgow*, Members Night. Feb. 27, *Christchurch*, Lecture Competition; *Preston*, "Investigation of Aircraft Accidents," by E. L. Ripley; *Reading*, "Boundary Layer Control and its Engineering Aspects," by Dr. G. V. Lachmann and J. B. Edwards. Mar. 5, *Boscombe Down*, Film and/or Medal Lecture Evening. Mar. 6, *Luton*, "Advantages and Disadvantages of Swept Wings," by D. Kuchemann. Mar. 13, *Weybridge*, "Problems of Jet Transport Operation," by J. T. Dyment; *Bristol*, Fourth Barnwell Memorial Lecture. Mar. 14, *London Airport*, "Problems of Jet Transport Operation," by J. T. Dyment.

A New Outlook on Helicopter Vibration

Important Experiments with a Dragonfly Described in Westland Chief Designer's Paper

AT a joint meeting of the Helicopter Association of Great Britain and the Royal Aeronautical Society, on February 12th, Mr. O. L. L. Fitzwilliams, B.A., A.F.R.Ae.S. (chief designer, Westland Aircraft, Ltd.), presented a paper entitled *Vibration Problems Associated with the Helicopter*. The chairman was Dr. G. S. Hislop.

Printed copies of the paper had been widely circulated in advance, and the author therefore confined his remarks at the meeting to a brief summary of its contents, together with a more detailed discussion of the analysis methods employed, thereby leaving more time available for general discussion. Two short films were also shown.

In his written paper, Mr. Fitzwilliams had begun by saying that the helicopter was capable of development into an exceptionally smooth vehicle. Although there was room for improvement in present-day machines with regard to noise and vibration, the helicopter possessed one most important attribute: its rotor was a natural gust-alleviator. On short-haul trips at low altitude, for which the helicopter was primarily intended, this was a distinct advantage; and the tendency could be extended further by suitable development of the control system.

Many existing helicopters had an unpleasant wallowing motion in rough air, partly owing to the manner in which their torque balance was achieved, but experiments with the Widgeon had indicated that a considerable improvement was possible by closer attention to correct "feel" in the pilots' controls.

The first specific vibrations to be examined were those arising from minor mechanical design-faults and from the engine. Those emanating from the engine were not normally felt by the occupants of the helicopter but might be important from the fatigue point of view. The problem of anti-vibration mountings was a difficult one to resolve: particularly in the case of instrument panels, if the mountings were soft enough to attenuate piston-engine vibrations they would usually amplify lower-frequency vibrations emanating from the rotor. However, the introduction of the gas-turbine engine to helicopters would eliminate this particular problem.

Surprisingly little vibration was found to be caused by transmission systems in present-day helicopters. Most of the serious design-errors leading to vibration from this source had by this time been made, and it could be assumed that they would not be repeated. Such vibration as did arise from this cause could be eliminated by normal modification action during the operational life of the type. The avoidance of natural frequency responses in the airframe (responses due to an excitation from the engine or rotating mechanism) was now a matter of standard practice in the design stage and should not cause significant problems in future designs.

Control-system vibration in the conventional helicopter arose mainly from friction in the blade pitch assemblies and compressibility effects at the blade tips. Both could be greatly reduced, if not entirely eliminated—friction by means of tension/torsion-rod assemblies and compressibility effects by means of a slight increase in rotor solidity. The problem was not present in systems incorporating power-operated controls. It would be of great value if an effective form of aerodynamic servo for rotors having more than two blades could be developed, so that duplication of powered control systems would be avoided.

Having disposed of the foregoing problems, which had either been resolved or for which solutions were available to render them innocuous as far as a "threshold of comfort" was concerned, the paper then dealt with two major sources of helicopter vibration, namely, stalling of the retreating blades and the second harmonic of flapping. The two were closely linked, and an exhaustive study of the phenomena had been made in a series of trials with a four-bladed rotor fitted to a Westland Dragonfly. The object of these trials had been to demonstrate that stalling of the retreating blade did not constitute a true limitation to the helicopter's possible maximum forward speed as was commonly supposed, provided that the rotor design was such as to eliminate major vibration emanating from the flapping motion of the blades.

In symmetrical vertical flight, the blades of an articulated rotor produced a constant lift moment about their flapping hinges irrespective of position in azimuth; they therefore revolved in the surface of a cone. The tilt of this cone with respect to the rotor drive-shaft axis was the first harmonic of flapping. As forward speed was introduced, the blades whilst passing through the "retreating" quadrant of the rotor disc became progressively unable to generate sufficient lift to maintain their path in the cone's surface. Loss of lift on the retreating side would cause a nose-up precession of the rotor disc were it not for the pilots' instinctive reaction in moving the control column forward. This control movement, through the cyclic-pitch mechanism, reduced the lift of the blades on the "advancing" side of the disc until lift moments on both sides of the rotor were once again in equilibrium.

It could be readily understood that this new condition of equilibrium in forward flight was characterized by a reduction of lift in the lateral quadrants of the disc and a corresponding increase of lift in the fore-and-aft quadrants. In this state, therefore, each blade was subject to a twice-per-revolution variation in lift moment generated about the flapping hinge, the upward flapping displacement being greatest where the lift moment was least (i.e., laterally) and least where it was greatest (i.e., fore and aft). In a two-bladed rotor the blades would be coned upward to the greatest extent when athwartships and to the least extent when fore and aft. Thus the helicopter would be subjected to a vertical vibration owing to the second harmonic of blade flapping.

In addition, the machine would be affected by vibration at the same frequency, caused by discontinuities of lift and drag forces associated with blade stalling in the retreating quadrant. When the tip speed ratio was small, lift and drag forces developed by the retreating blade were large and, consequently, large vibrations were the result. However, when the tip speed ratio was large, lift and drag developed by the retreating blade was small, so that the discontinuities associated with stalling were no longer a serious cause of vibration. Furthermore [as the author showed in illustrations and explained in his subsequent report of the flight experiments], as the forward speed of the helicopter increased,

Fig. 1. Vertical vibration in cabin: preliminary vibrograph results.

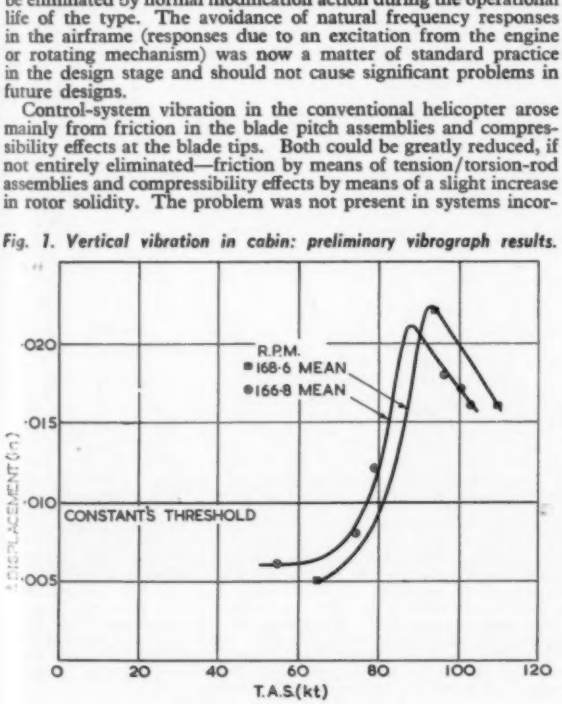
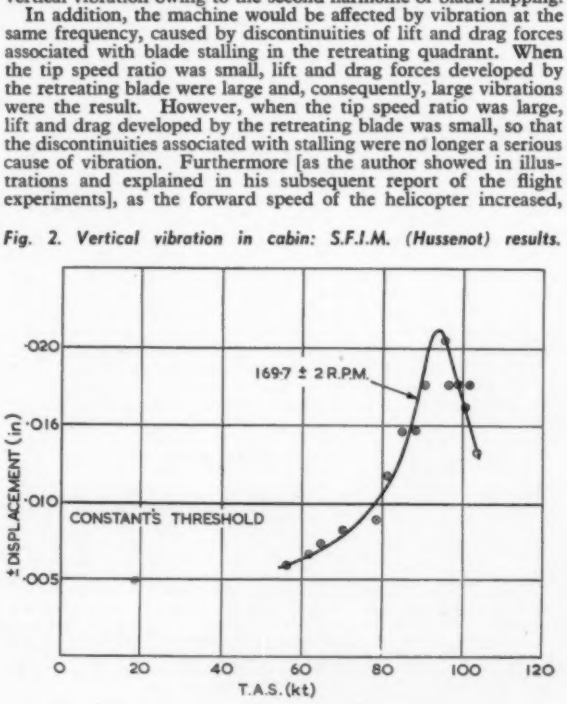


Fig. 2. Vertical vibration in cabin: S.F.I.M. (Hussenot) results.



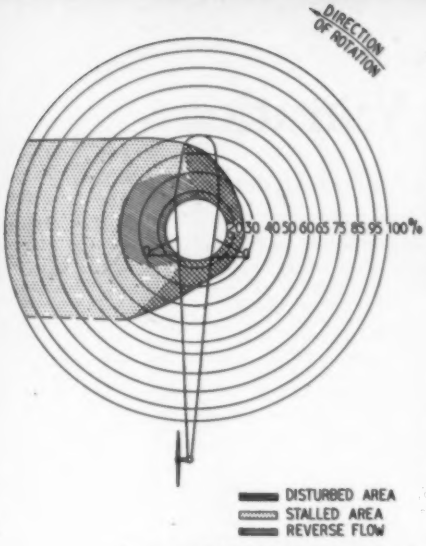


Fig. 3 (left): Airflow characteristics over blade, showing area of blade stall on the retreating side at high forward speed.

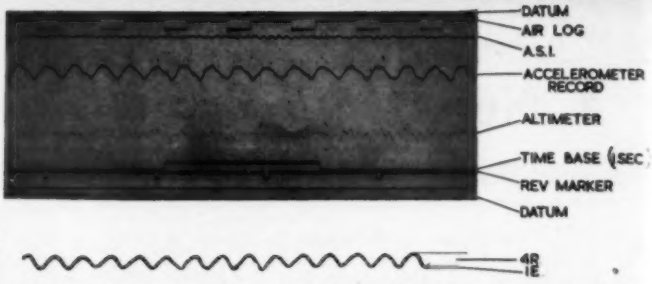


Fig. 4. Vibration record from "four-blade" Dragonfly, showing 4R vibration with a small amplitude of 1st engine order.

A NEW OUTLOOK ON HELICOPTER VIBRATION . . .

that part of the vibration due directly to blade stalling was reduced.

Mr. Fitzwilliams went on to show that there would then remain only the vibration due to the second harmonic of flapping. If a four-bladed rotor were used, the vertical vibration of each pair of blades arising from this source would automatically be counterbalanced by the vibration from the other pair, thus achieving the desired result.

For the flight experiments, therefore, a four-bladed rotor was fitted to a Westland Dragonfly. A high tip-speed ratio, to reduce the severity of vibration due to blade stalling, was obtained by conducting the tests at aircraft and rotor speeds of 109.5 kt and 168 r.p.m. respectively. The flight-path varied from a slight climb at low airspeed to a relatively steep dive at maximum airspeed. To measure the rotor speed with accuracy, an S.F.I.M. (Hussenot) A.23 recorder was used and a trailing airlog gave simultaneous recording of true airspeed. Vibration measurements were recorded by two methods: by a hand-held Kelvin vibrograph (Fig. 1) and by S.F.I.M. accelerometers bolted to the structure and connected to the A.23 recorder (Fig. 2). The results were substantially the same by both methods.

These results proved that, with the vibration due to the second harmonic of flapping eliminated by means of the four-bladed rotor, it was possible for the helicopter to fly through the period of maximum vibration caused by retreating-blade stall. It was not, therefore, a barrier to increased forward speed. One way of avoiding the worst phase of this vibration whilst accelerating to higher cruising speeds was for the pilot to adopt the technique of maintaining rotor r.p.m. at a slightly higher value than normal during the initial acceleration. At a convenient moment later, an increase in collective pitch would cause the rotor speed to fall rapidly to the normal cruising r.p.m. and the vibration peak would cause only a momentary disturbance.

The only vibration present in the test aircraft, apart from some engine excitation, had been the nearly pure simple harmonic displacement at "once-per-blade" frequency (Fig. 4) which could have been suppressed by a mechanical vibration-absorber geared to the transmission.

Thus, the requirements for smooth helicopter operation at high forward speed—a moderate reduction of blade-loading coefficients, the use of rotors with four (or more) blades, and the introduction of the gas-turbine engine—were all incorporated in the design features of the next generation of helicopters which would shortly be in production. The paper concluded with a mention of a number of other factors which caused vibration, including the third, fourth and fifth harmonics of flapping. These were, however, of secondary importance. Such other factors as the accurate matching of rotor blades, optimum design of drag-hinge dampers, etc., were matters which were already being perfected by known techniques.

THE DISCUSSION

PROFESSOR J. A. J. BENNETT (College of Aeronautics) congratulated Mr. Fitzwilliams on having attained a valuable "first" in the field of helicopter development. There was no doubt that the four-bladed Dragonfly had been operating under conditions of periodic blade-stall; but he thought that, since the higher speeds had been obtained in a dive, the rotor would have been near to the autorotative condition, operating in a similar manner to the Gyrodyne. He wondered whether this might have been a contributory factor in the reduction of vibration experienced and whether the machine would have been rougher had sufficient power been available to have maintained level flight in the tests. It certainly appeared that limits of forward speed could be set for various rotors, two-bladed up to 90 kt, three-bladed up to 125 kt and four or more blades for speeds in excess of this.

It was interesting to recall that these problems had not been unknown to Cierva, who had termed them "bouncing due to flapping" and "bouncing due to bending." Vibration in the early Autogiros had been well below the threshold of discomfort. A suggested cure, emanating from a source in the U.S.A., for "bouncing due to bending" was to incorporate a flapping hinge in the blade spar to allow the outer part of the blade to have independent flapping motion.

MR. W. STEWART (R.A.E.) thought that the lecturer might have exaggerated the interpretation of the results of the tests to a certain extent. Considerably more flight testing would be needed before these could be established with certainty, owing to the inevitable experimental scatter of points on the vibration curves produced. However, that did not minimize the value of the work and there was no doubt that a "hump" in the vibration curve did exist.

The main difference between the early Autogiros and present-day helicopters, apart from the Autogiros' lower disc-loading and blade loading, was the difference in Mach number on the advancing side. Helicopters were now operating at a Mach number of 0.85, but Autogiros had never approached near to this value. The ability to make use of higher-tip-speed ratios certainly held promise of the attainment of higher airspeeds for helicopters, and he hoped more work would be done to achieve this end.

There was one interesting factor, concerning a peculiar condition through which the blade passed in the forward quadrant of a rotor in forward flight, that had an important bearing in the matter. In the forward position, the relative airflow over the blade was the equivalent of giving it a marked angle of sweep-back. This varied from approximately 30 deg at the tip to over 60 deg at the inner part of the blade. The angle at half the blade radius was about 45 deg. As the blade moved round towards the retreating quadrant the regime changed until, at the approach of the stall, the relative airflow was straight. This was important if the blade lost lift suddenly, as the sweep-back was an alleviating factor which ensured a smoother transition from the high lift condition to the stalled condition.

MR. RAOUL HAFNER (Bristol Aircraft), after commenting on ways of determining criteria for the vibration "threshold of comfort," said he thought that one of the films shown (of models demonstrating vibration caused by the various harmonics of flapping) had been of particular value. He agreed that an improvement in vibration characteristics could be achieved by increasing the number of blades, but that did not eliminate the need for a stub wing. As the lecturer had said, it was desirable to decrease blade loading to reduce the effect of stalling on the retreating side, and this was exactly what the stub wing achieved.

Later in the discussion Mr. Hafner qualified his remarks by saying that the stub wing was also useful in keeping the coning angle of the rotor at a low value in high-speed flight, thereby reducing vibration caused by variation of inflow with the rotor tilted forward. He explained that, at high coning angles in this flight condition, the inflow angle with respect to the blades was greater in the rear quadrant of the rotor disc than in the forward quadrant. This gave rise to a variation of blade drag in the cycle of rotation.

MR. R. H. WHITBY (B.E.A.) presented some extensive data regarding permissible vibration levels. He was delighted to see that at last someone had extended the work of Gustafson on blade stalling which, excellent though it was, had been carried out with a helicopter of very limited characteristics, the R-4. He hoped that on future passenger helicopters the vibration likely to be experienced when passing through the region of the so-called "blade-stall barrier" would not be of sufficient magnitude to be disturbing to the occupants. He was also rather concerned at the possibility of blade flutter in the stalled condition. It would, perhaps, have been better had flutter been experienced during the test flying, and cured, rather than that it should never have occurred at all. Finally, he asked what was the cost of the additional speed in terms of power.

MR. A. MCCLEMENTS (Bristol Aircraft) congratulated the lecturer on a paper displaying a high degree of originality. He had had some association with the work at an earlier stage and he was certain that Mr. Fitzwilliams was on the right track. It was a pity that the equipment to achieve even higher tip-speed ratios had not been available. He thought that some caution was necessary in applying the results. The test aircraft had not experienced blade resonance with the metal rotor blades used, but this might not be the case with wooden-bladed rotors.

MR. E. T. JONES (president of the R.Ae.S.) thought that there was more to helicopter vibration than those described by the lecturer. It was quite correct to say that the early Autogiros did not vibrate so much, but there was a very big difference in solidity. The blade chord on one of the machines, he recalled, had been 2ft 4in. It had been a four-bladed rotor with heavy inter-blade cables, each with a 2 lb lead weight in the middle. These must have affected vibration. Another point concerning the "unloading" of the rotor by stub wings was that the original Autogiro did not strictly have a stub wing. It had a shaft carrying two 3ft aerofoil surfaces at the outer extremities, the primary purpose of which had been to provide aileron control.

(Concluded at foot of page 254)

An uncommonly fine impression of a Hunter echelon. These F.6s of No. 92 Squadron are being flown (left to right) by S/L. W. G. Greer (officer commanding), F/L. D. A. Arnott, D.F.C., F/L. A. W. A. Wright, and F/L. M. M. Foster.

(Below) Emerging from a loop, near Bridlington, is this trio of 92 Squadron Hunter F.6s, with under-wing Bristol asbestos-phenolic tanks.

HUNTER SIXES

NOW in service with R.A.F. squadrons is the F.6 variant of the Hawker Hunter. One squadron so equipped is No. 92, based at R.A.F. Station Linton-on-Ouse, Yorks, and it is aircraft of this unit which form the subjects of these pictures. The F.6 Hunter is characterized by a more powerful mark of Rolls-Royce Avon turbojet, which confers an exceptional rate of climb and a higher ceiling than was achieved by earlier marks.

No. 92 Squadron was formed in September 1917 and, equipped with S.E.5As, crossed to France on July 1, 1918. It was dispersed in August of the following year. On re-forming in 1939 it was equipped with Blenheim Is and later with Spitfires.

Incorporated in the squadron badge (worn on the nose of each Hunter as the centrepiece of the squadron markings) is a cobra, commemorating the presentation of the original No. 92 Squadron as a "gift" from East India.

The pictures are the work of Mr. M. H. ("Mick") Chase, M.M., of the Air Ministry, who in recent years has specialized in air-to-air photography. His success in this direction has just won for him a Fellowship of the Royal Photographic Society.

(Right) An immaculate turn to port, in echelon starboard, by the same Hunter F.6s as depicted at upper right. The squadron marking is red and yellow dicing.

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Chipmunk Airworthiness

MAY I trespass on your valuable space to comment on Mr. L. W. Wenman's letter on Chipmunk Airworthiness, published in your issue of February 1?

The experience of Airways Aero Associations, Ltd., in obtaining the necessary modification parts and other details, enabling them to obtain civil certification for sixteen Chipmunk Mk 22 aircraft must be almost unique. Perhaps they are a privileged body?

My club bought two of these aircraft ex-R.A.F. in May 1956 and both were flown to Fair Oaks in a perfectly airworthy condition. To date neither has as yet obtained a Civil Certificate of Airworthiness because of the delay in the delivery of modification parts ordered from the manufacturers in June and July of last year. These parts are at last to hand and we may therefore complete the remainder of the airworthiness formalities some time during the current month. Thus some eight months will have passed in converting an airworthy military aircraft into an airworthy civil aircraft.

Not only has the cost of the conversion been excessive but the intolerable delay has caused a loss of revenue—serious matters for a club struggling to make a living.

With particular reference to the Air Registration Board, while I appreciate the courtesy and help of their individual inspectors, I deplore their airworthiness policy in regard to Chipmunks. I can see no good reason why this fine aircraft could not have been granted a civil certificate outright and any modification deemed necessary introduced piecemeal afterwards, thus enabling these aircraft to earn their keep instead of "eating their heads off in the stable" for so long a period.

Chobham, Surrey. C. ARTHUR,
C.F.I. and manager, Fair Oaks Aero Club.

The Disbandment

I UNDERSTAND that any workable plan for retention of the R.Aux.A.F. will receive sympathetic consideration. If this is so, I should very much like to submit my idea, which I think would not only be economical but would fulfill a much-needed service to the country. Details, in brief, are as follows:—

Flights to be formed throughout the country consisting of, say, six Austers, one Anson and, later, one helicopter. *All* personnel, including pilots and ground crew, to be unpaid volunteers. All units after the initial formation to be self-supporting. All personnel equipment—tools, overalls, flying clothing, etc.—to be supplied by members themselves.

The rôles to be filled by these units would include: (1) Carriage of spares, etc. (2) Military and civilian medical emergency transport, for which a charge could be made on the National Health Insurance. (3) Transport for Service personnel (or their dependants) in cases of emergency, for which a small charge would be made. (4) Rescue operations. (5) Police co-operation (for which they would pay). In fact, they would do anything which did not encroach on civilian private charter or airline activities. When the machines and pilots were not required for any of these duties the unit could be run as a flying club, with each person paying his own fees, expenses, etc.

Pilots and necessary ground crews could be called out by the local police on a roster system, 24 hours a day and seven days a week. In the event of hostilities these activities could be extended to include co-operation with Civil Defence organizations, and a hundred-and-one other useful occupations.

Newark, Notts. P. W. HEELEY.

Where's That Tiger?

AS you are no doubt aware, the de Havilland Tiger Moth aircraft completes 25 years' continuous service on Sunday, March 3, and the Tiger Club is on that date holding a meeting of Tiger Moths at Fair Oaks Aerodrome (by kind permission of Universal Aircraft Services, Ltd.) in order to celebrate this unique event.

The first Tiger Moth, G-ABRC, was in the early part of the war impressed into the Services as BB723, and it was last heard of some six years ago, still flying with the Royal Navy. It would be interesting to know if this historic machine is still flying with the Services, and still more interesting to see it at Fair Oaks on March 3. Any information as to its whereabouts or ultimate fate would be very welcome to the undersigned, c/o 49 Zermatt Road, Thornton Heath, Surrey. C. NEPEAN BISHOP,
Hon. Secretary, the Tiger Club.

Performing Flea

WITH reference to Mr. Graham's letter in your issue of January 18, and out of fairness to Fleas, I feel it is worth recording that G-AEKR elevated itself to the status of a performer, in the hands of Mr. R. Parker, at Doncaster Airport on May 28, 1937. That was the first of its four flights, and after a last leap on June 23, 1937, it was overtaken by the Air Ministry's ban on performing *Poux*.

It was built by Mr. A. F. Raynor and partners at Claybourns Garage, Doncaster, during the winter of 1936-7, and was fitted with an Anzani vee-twin engine. To the best of my knowledge, it has been housed at its place of birth ever since it was forcibly grounded, though it did make a brief static appearance at Finningley R.A.F. station on September 17, 1950.

London, E.6. D. K. Fox.

U-2 on the Screen?

HAVING read in your magazine about the mysterious Lockheed U-2 and having seen photographs of it, I wonder if any reader who saw the film *On The Threshold Of Space* noticed the painting of what appeared to be the U-2 outside the door of the room where the design of new helmets was in progress? At the time I saw the picture I had not read of the U-2, and it is only now that I realize that the photograph in *Flight* rang a bell.

Athlone, Eire. DESMOND A. MCCARTHY.

A NEW OUTLOOK ON HELICOPTER VIBRATION (continued from page 252)

MR. T. L. CIASTULA (Saunders-Roe) said he thought it was necessary to consider the whole problem from a wide viewpoint and see what the effect of higher tip-speed ratios would be on other aspects of design, such as the control system. He suggested that there might be an appreciable increase in "in-plane" vibration. While it might be tolerated for power controls, it might prove to be critical in direct manual systems.

MR. J. W. LEACH (A. and A.E.E.) considered it might be advantageous to divide the problem into two sections: vibration on structure and vibration affecting occupants. At his establishment they had been able to obtain the reactions of a large number of pilots to a variety of vibrations. From the statistical analysis produced, it appeared that a time factor should be included.

S/L. J. DOWLING (Central Flying School) wondered whether the irregular yawing vibration experienced in some helicopters could be caused by torque variations which resulted from turbulent air. He mentioned, as an example, that it was quite possible in tropical countries to experience an up-gust that would overspeed the rotor to such an extent that it became disengaged from the engine.

MR. J. S. SHAPIRO (consultant) wished to emphasize the point made by the lecturer that a helicopter rotor was a natural gust-alleviator; he was particularly anxious that it should be noted by the A.R.B. representatives. He had a criticism to make regarding power requirements, as he was not convinced that higher speed could be attained with more blades. There were other ways and the problem was to decide which was the cheapest. He disagreed with one of the lecturer's generalizations on the subject of the necessity to incorporate a gimbal mounting in a hub for a two-bladed rotor; according to the latest investigations by the Bell Company, this was no longer regarded as an essential feature.

MR. FITZWILLIAMS, in reply to the discussion, said that he accepted the views expressed concerning the desirability for more extensive evidence. He was aware that the quantity of test results obtained at the present juncture was inclined to be small but he was, nevertheless, convinced that these results would be confirmed by further testing. He was not opposed to the use of a stub wing provided that it remained a stub. If the blade area was sufficient to function satisfactorily the stub wing was not necessary. Because of its susceptibility to gusts, a large stub wing could cause sudden loading and unloading of the rotor in turbulent air conditions. If it was merely a question of preserving a low coning angle, this could be achieved by introducing a small additional weight at the blade tips.

Vibration caused by blade stalling at a once-per-blade frequency could be suppressed by a suitable mechanical device and need not be a disturbance to occupants of the helicopter. This was already standard practice by piston-engine designers to counterbalance engine crankshafts. The source of the irregular yawing vibration had definitely been established as a beat between a normal three-times-rotor-speed excitation and another excitation at the natural lateral bending frequency of the fuselage. It was not due to variations in torque, but was probably affected by the highly disturbed airflow at the centre of the disc. So far as power requirements were concerned, he was sure that this factor favoured the pure helicopter. If power was applied to propellers there was bound to be a wastage.

He looked forward to seeing further research work carried out in respect of the whole problem.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

What the camel thinks of the Aden-Yemen border troubles is not conveyed by his expression as, with a member of the Aden Government Camel Corps proudly astride, he mounts guard on an R.A.F. Venom.

A.V-M. F. R. W. Scherger, C.B., C.B.E., D.S.O., A.F.C. (below) is to become C.A.S. of the R.A.A.F. He succeeds Air Marshal Sir John McCauley, K.B.E., C.B., who reaches retiring age on March 18. A.V-M Scherger, aged 52, is now Air Member for Personnel.

Future of the R.A.F.

RECENT speculations about the future of the R.A.F. were put into perspective by Air Chief Marshal Sir Dermot Boyle, Chief of the Air Staff, when he spoke in London on February 14 at the official opening of Hulton House in Fleet Street.

Sir Dermot said that there had been "a lot of loose talk" about rockets making the R.A.F. obsolete, but this was "terribly far from the truth." If there were war in the next five years, it would be the fighter pilots who defended us, and the R.A.F. would be with us for many years to come.

"A lot of people say it is a waste of time to try to defend this land in the nuclear age," went on the C.A.S. "They may be right, but I don't think so. History shows that every offensive weapon is countered. Who would have thought in 1939 that we should be destroying hostile bombers in the air, in the dark, and at 30,000ft. Who are we to say that five years hence we shall not be destroying ballistic missiles 100 miles up on their way to fall on this country? I don't think that the problem is any more difficult relatively than was the problem in 1939 of destroying bombers at 30,000ft." [Editorial comment, page 229.]

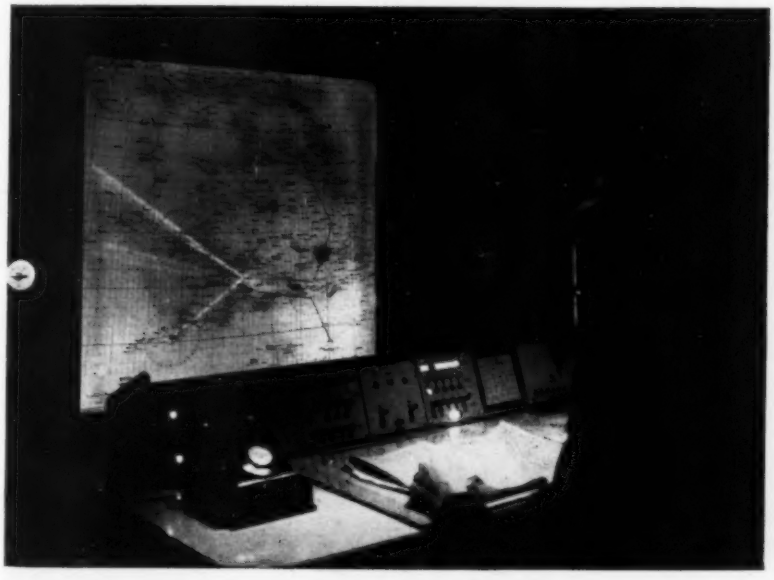
F.A.A. Fixer Service

AUTOMATIC fixer control stations for Service aircraft—the first of their kind in Britain—are now in use by the Fleet Air Arm at the R.N. air stations at Yeovilton, Somerset, and Abbotsinch, near Glasgow. They cover the whole of the United Kingdom and much of the surrounding seas.

The southern chain comprises Yeovilton, Stretton, Ford, Culdrose and Brawdy, with control at Yeovilton; the northern chain comprises Abbotsinch, Anthorn, Eglinton and Lossiemouth, with control at Abbotsinch. Control stations have remote control of the transmitters and receivers of other stations in their chain and can contact aircraft *via* whichever station is nearest.

In front of the Wren operator is a map of the U.K. on plate glass with a Perspex diffusing screen. Behind the screen is a projection unit consisting of up to ten CR/DF (F.V.10) receivers, each remotely fed from the D/F sets of the particular stations. From these simultaneous bearings, pilots can be given their positions in less than five seconds.

This Standard Telephones and Cables "automatic triangulation system" came into operation during last year.



A Wren operator at R.N.A.S., Yeovilton, watching simultaneous bearings given by the new F.A.A. "fixer service" (described above), which enables pilots to receive their positions within five seconds. "Flight" photograph

Wymeswold Wing Disbands

AT the "dining-out" of Nos. 504 (County of Nottingham) and 616 (South Yorkshire) Sqns., R.Aux.A.F., at R.A.F. Station Wymeswold last Friday, Lord Sherwood of Calverton, who formed No. 504 and was its first commanding officer, said the amount saved by the disbandment of the R.Aux.A.F. was "just a drop in the ocean." The Auxiliary squadrons had played their part in the defence of their country and perhaps had achieved something more than they set out to do; voluntary service was essential in the public life of this country.

The toast of the squadrons—which together formed the Wymeswold Wing of the R.Aux.A.F.—was proposed by A.V-M. H. P. Fraser, C.B., C.B.E., A.F.C., A.O.C. No. 12 Group. "The Auxiliary Air Force is known for its courage, grit and example," he said. "You in the Wymeswold Wing have been wonderful and the Royal Air Force is losing a part of itself."

Equerry to the Duke

SINCE Lt-Cdr. M. Parker's resignation, S/L. H. M. Chinnery has been in attendance on the Duke of Edinburgh as equerry. S/L. Chinnery, who is 33, joined the R.A.F. in 1941.

Dunning Cup Award

AWARDED annually to the most successful squadron on an anti-submarine course, the Dunning Memorial Cup was last Monday presented to No. 120 Sqn. at Aldergrove, N.I., by the A.O.C-in-C. Coastal Command, Air Marshal Sir Bryan V. Reynolds.

Long-distance Sortie

THREE R.A.A.F. Neptunes were due to leave Sydney on February 20 to undertake the Service's longest peace-time operation. Flying *via* Darwin, Singapore, Karachi, Aden and East Africa, the aircraft are scheduled to reach Accra on March 1 for the Ghana independence celebrations.

Mr. W. E. W. Petter, Folland managing director and chief engineer, speaks at the prize presentation reported in Col. 1. Also seen on the platform, from left to right, Messrs. J. Keiser (Folland education officer); R. M. Marsh (Hampshire education officer); T. Gilbertson (director); and D. B. Smith (assistant chief engineer).

THE INDUSTRY

Folland Apprentices' Prizegiving

AFTER presenting prizes to Folland Aircraft apprentices at Hamble on February 6, Mr. R. M. Marsh, M.A., the County Education Officer, commented on the post-war growth of industry and population in Hampshire, which had resulted in a doubling of the number of young people to be catered for in schools and colleges.

Mr. Marsh endorsed a plea made earlier by Mr. J. Keiser, Folland education officer, when reporting on the year's activity, for a recognition that advanced technical training could only be based on sound groundwork in primary and secondary schools.

It was not the business of professional educationalists to train people for industry; from his impression of the facilities available at Folland Aircraft, this was better left to industry itself. The educationalists should produce good citizens with a wide range of interests; they could let industry know more of what the schools were trying to do, and industry should say what their requirements were. Technical colleges were the structure on which such co-operation could be based.

Mr. Marsh was introduced by Mr. W. E. W. Petter, managing director and chief engineer, who said this was the first time the prizegiving had been held in the new sports and social club, and the opportunity had been taken to show examples of work done by the apprentices in the training workshop, on production, and in off-duty activity.

G. D. A. Redman, gaining a first-class Final City and Guilds Certificate in sheet-metal work and a first prize for practical work submitted, received a cup (donated by Mr. Petter) as the year's most outstanding apprentice.

—and Three Hamble Appointments

AN announcement from Hamble says that Mr. G. Thripp, O.B.E., M.I.E.E., A.F.R.Ae.S., has joined the Folland Aircraft, Ltd., commercial department and will be responsible for foreign contracts.

Mr. Thripp was with Air Service Training, Ltd., as deputy principal of the Indian Air Force Technical Training College from 1949 to 1956. Previously he had served with the R.A.F., joining in 1929 as an aircraft apprentice and being promoted group captain in 1944. He was made O.B.E. (Civil Division) in the New Year Honours 1956.

Folland also announce the appointment of Mr. H. Parr, who was formerly engineering controller at Avro Aircraft, Ltd., Canada, as design office manager, and of Mr. P. Norman, formerly assistant chief flight development engineer, as chief aerodynamicist.

Messrs. Thripp, Parr and Norman.

Big Dollar Order for Pyrene

STATED to be the largest of its kind ever placed in the United Kingdom, an order valued at approximately 1½ million Canadian dollars, for crash fire tenders for the Royal Canadian Air Force, has been received by the Pyrene Co., Ltd., The order is the result of close co-operation between the British parent company and its subsidiary in Canada, culminating in a personal visit to Ottawa by the chairman of the British company, Mr. F. A. J. Harrison.

The type of vehicle selected is the Pyrene Mark VI—similar to that which the company is already supplying for the R.A.F. —which can project foam at the rate of over 5,000 gal/min. Built on an Alvis M.o.S. 6 × 6 chassis powered by a Rolls-Royce engine, it can operate over exceptionally rough or boggy ground.

Following Mr. Harrison's visit, another order for Pyrene crash trucks has also been received from the Canadian Department of Transport (Civil Aviation).

Other news from Pyrene is that they have established a new research and development division further to improve co-ordination between their various departments concerned with fire-research, development and experimental work. Appointed controller of the new department is A. Cdre. J. A. Hawkings, C.B.E., R.A.F. (Retd.), M.I.Mech.E., A.F.R.Ae.S. A former test pilot at the R.A.E., A. Cdre. Hawkings held several commands before 1948, when he was loaned on exchange to the U.S.A.F. for research and development work at Wright Field. In 1953 he was appointed Director of Servicing (Research and Development), M.o.S., in which capacity he was responsible for the development of airfield crash tenders for the R.A.F. In 1955 he became Director of R.A.F. Fighter Research and Development, holding this post until his retirement a year later after 31 years in the Service. He has already taken up his new appointment with Pyrene at their H.Q. on the Great West Road, Brentford.

IN BRIEF

A £150,000 order for electronic equipment for the ground control of aircraft has been placed by the Royal Swedish Air Board with J. Langham Thompson, Ltd. Similar equipment, to the value of £75,000, has been ordered from the same company by the Ministry of Supply. J. Langham Thompson are one of the companies within the Camp Bird Industries Group.

W/C. E. G. Monk has been appointed regional manager, United Kingdom, for the Bendix Aviation Corporation. In his new post he will have particular interest in the granting of manufacturing licences and the acquisition of licences to manufacture British equipment in the U.S.A. After 23 years' service with the R.A.F., W/C. Monk joined Sangamo Weston, Ltd., in 1945 as their aviation liaison engineer. In 1952 he was appointed sales manager of the aviation division of Elliott Brothers (London), Ltd., a post he relinquished early this year.

Mr. A. S. Bishop, managing director of the Goodyear Tyre and Rubber Co. (Great Britain), Ltd., is visiting the Goodyear factories in Buenos Aires, Argentina, and in Sao Paulo, Brazil, during a six weeks' visit to South America.

* * *

Henry Bissell, Ltd., 48 Beauchamp Place, London, S.W.3, have been appointed sole concessionaires in Great Britain for the sale and manufacture of the products of the Elcon Manufacturing Co., 436E Manchester Avenue, Los Angeles, 3, Calif, U.S.A., including the standard Elcon battery quick-disconnect and receptacle.

* * *

In the constructors' list of suppliers of materials and parts for the Britannia, published in our issue of February 1, a reference to "Nimonic steel bar" should, of course, have read "Nimonic alloys" —the well-known Henry Wiggin nickel-chromium materials for high-temperature applications.

CIVIL AVIATION

Although no major structural change has been made to the Comet 3 during its refit to 4 and 4A standard, a fuselage pressure-test—seen here in progress—was one of the routine checks made before its first flight. This was due to take place as we went to press. Other changes include the installation of Rolls-Royce RA.29 engines, the fitting of detachable wing-tip panels, and the installation of a revised cabin-air system and elevator "q"-feel.

OLD SORES

TWO events in the British air transport scene last week gave us pause for sad reflection. One was the frustration of a leading independent airline—Hunting-Clan—about the terms of reference which continue to restrict its use of new equipment on Colonial coach services. The other was the suspension by B.E.A. of scheduled passenger helicopter services in the United Kingdom until the "advent of an economic helicopter."

There was a certain irony about the fact that at London Airport last week the Minister of Transport and Civil Aviation said—almost within sight of two new Viscounts lying idle at the Hunting-Clan maintenance base—"Let me make it plain that I consider that the independent airlines, as well as the Corporations, have an important part to play in aviation's future." How to give to the independents a bigger share was not, said Mr. Watkinson, easy; but he was "encouraged by the very great enterprise which has been shown by independent operators in developing the limited opportunities which they have so far been given."

It is, of course, inevitable that the day will come when the Vikings with which Hunting-Clan and Airwork have operated their Colonial coach services since 1952 will have to be replaced by newer equipment. But any move to do so is vitiated by the Government terms of reference under which those services are operated. Hunting-Clan knew those terms when they ordered Viscounts two years ago, and they had to adhere to them (the Viscounts were leased to Middle East Airlines). Then, last December, they took delivery of two more new Viscounts—and the issue came to a head again. "It is extraordinary," Mr. M. Curtis (Hunting-Clan managing director, is quoted as having said last week, "to suggest that you must never replace your aircraft with more up-to-date ones."

It will be remembered that Airwork as well as Hunting-Clan had to dispose of their new Viscounts (to Cubana)—though the aircraft were bought in full knowledge of the conditions upon which the companies started Colonial coach services five years ago. We turned up the exact terms of those conditions, as laid down by the Government to the Air Transport Advisory Council on July 30, 1952. The crucial phrases appear to be those we have put in italics: ". . . a Colonial coach-class service will have to be: (a) a lower class of service than that of normal scheduled services, e.g., *as regards type of aircraft*, shorter stage lengths, passenger amenities, baggage allowance, etc.; and (b) operated to a stated frequency closely related to the requirements of the new class of traffic in the territories in which rights may be exercised and at a fare not exceeding a fixed sum (without rebates) low enough to ensure dependence on the new class of traffic." And a further condition: ". . . provided the proposed service is of such a nature as to generate a new class of passenger traffic *without material diversion of traffic from the 'normal scheduled services' of any other previously approved U.K. operator*, and does not involve the right to pick up and set down passenger traffic in territories where relations with the U.K. are governed by bilateral Air Transport Agreements and/or where fares are subject to International Air Transport Association arrangements."

It is the opinion of Hunting-Clan that the Viscount would not have exceeded these limits. It is, apparently, the opinion of the Government that it would. There is another school of thought that the phrase "type of aircraft" might be deleted in recognition of the fast-moving pace of air transport, and of the fact that the Viking is old and relatively inefficient. The other conditions appear to be sufficient to ensure that there is "no material diversion" from B.O.A.C.'s traffic, especially as the Corporation is now so competitively equipped with Britannias. One hopes that the two Britannias ordered by Hunting-Clan—due for delivery early next year—do not await the same fate as the company's Viscounts, although their future seems less uncertain when considered in the light of a news item on page 260.

* * *

We recorded last week the news of B.E.A.'s decision to shelve their helicopter plans. (We should have made it clearer, incidentally, that by "helicopter plans" we meant scheduled passenger services. The Corporation's helicopter unit will continue in being on a charter and experimental basis.) The reason given by B.E.A. was that such services must await the advent of an economic helicopter.

A weighing of all the factors—particularly of B.E.A.'s persistent efforts, with and without Ministerial support, to get helicopter passenger services going—leads to the conclusion that this is an unhappy decision. This is a feeling shared by many people within the Corporation as well as by the helicopter manufacturing industry, and which can be expressed by the argument that if in 1920 the airlines had decided to wait for the DC-3 there would have been no DC-3—and, even if there had been, no one would have known how to operate it.

Agreed, B.E.A. have amassed a good deal of experience with helicopter scheduled services, from their South Bank-London Airport schedules of two years ago, and during earlier services from L.A.P. to Southampton. But were these services—like the determined intensive operations of Sabena and New York Airways—on a scale by which the *expertise* essential to ultimate success and profitable public service is assured? And were they sufficient to generate helicopter-consciousness in the public mind?

Analogies with the Belgian and New York helicopter efforts are not inappropriate: there is in Britain a similar high density of population, and close proximity of commercial centres—the true breeding-ground of a demand for the benefits and facilities of helicopter travel.

Above all, there is a vigorous helicopter and gas-turbine industry, which is well aware of the helicopter's present economic infancy, yet whose products are attracting the interest of operators in the land of its strongest rival industry. It would be good to feel that it was building upon continuing domestic operational experience.

J.M.R.

CIVIL AVIATION . . .

FILLING THE ORDER BOOKS

WE present below a new edition of the airlines' shopping list, correct to February 18, 1957. Since the list was published in *Flight* on November 23 last, the following new orders have been placed:

Douglas DC-8: U.A.T., 5; T.A.I., 4.

Bristol Britannia: B.O.A.C. orders for 300 and 310 series aircraft were reshuffled from 11 310s and seven 300s to 18 312s, leaving five 300s (305s) available for Northeast and two 302s uncommitted. Hunting-Clan have ordered another 310 (314) and the total orders have risen from 56 to 65.

Lockheed 1649A: Air France orders for this aircraft now stand at 10 and not 12; the total is now 44.

Convair 440: Lufthansa have increased their order by seven.

Lockheed Electra: Allison have ordered one aircraft.

Vickers Viscount: New orders from old customers (Lufthansa, two more; L.A.I., four more) have increased the previous total of 357 to 363.

Vickers Vanguard: T.C.A.'s order for 20 has doubled the previous total of 20 aircraft for B.E.A.

Fokker/Fairchild Friendship: Orders for 20 more have been forthcoming; these were set out in detail in last week's issue.

PROJECTING A SHORT PHILOSOPHY

IN our description of the Short P.D.16 Transport Project (*Flight*, February 8) we made reference to the "most absorbing two-inch-thick" project-study brochure released by the company. The chapter dealing with the philosophy behind the design is, in our view, of quite unusual interest, for it provides a rare insight into the very basic decisions that must be made before even a tentative configuration can be planned.

The first design-problem to be tackled, the brochure indicates, was one of dimension. Should the new aircraft be of the size of the Bristol Freighter (44,000 lb), the Fairchild Packet (72,800 lb) or, perhaps, the Lockheed Hercules (130,000 lb)? The answer was found from a study of the requirements of many civil operators. Discussions led to the postulation that the new transport should be pressurized, turboprop powered and between 55,000 and 75,000 lb all-up weight—although the exact figure would depend upon the choice of powerplant.

Here the choice was by no means straightforward: piston engine or turboprop? Commenting that to prolong the maintenance of tools, spares and special fuels for piston engines might be inconvenient, the brochure philosophizes: "For the smaller operator, piston engines offer the attraction of being cheap to buy and familiar to his maintenance staff. In addition, there exists a world-wide chain of maintenance bases for this type of engine.

THE AIRLINES' SHOPPING LIST

Correct to February 18, 1957, excluding options but including certain government and corporate orders

Aircraft	Variant	Powerplant	Airlines (listed in order of purchasing)	Total
Douglas DC-8	Overseas or Long-Range	Pratt and Whitney JT4	PanAm,* 21 (Dec. 1959); United, 15 (May 1959); K.L.M., 8 (March 1960); Eastern, 18 (May 1959); J.A.L., 4 (1960); S.A.S., 7 (1960); Panagra, 4 (early 1960); Swissair, 3 (first half 1960, the third in 1961); U.A.T., 5 (1960); T.A.I., 4 (1960)	120
	Domestic	Rolls-Royce Conway	T.C.A., 4 (early 1960)	
		Pratt and Whitney JT3	United, 15 (May 1959); National, 6 (Midsummer 1959); Delta, 6 (June 1959)	
Boeing 707	120	Pratt and Whitney JT3	PanAm, 6 (Dec. 1958); American, 30 (operation on June 15, 1959); Continental, 4 (May 1959); T.W.A., 9 (April 1959); Qantas, 7 (Type 138, May to September 1959)	132
	220	Pratt and Whitney JT4	Braniff, 5 (Oct. 1959); Sabena, 4 (Dec. 1959)	
	320	Pratt and Whitney JT4	PanAm, 17 (March 1959); T.W.A., 18 (April 1959); Air France, 10 (Nov. 1959)	
	420	Rolls-Royce Conway	Lufthansa, 4 (Summer 1960); Air-India, 3 (early 1960); B.O.A.C., 15 (1960)	
Bristol Britannia	102	Proteus 705	B.O.A.C., 15 (current delivery)	65
	250	Proteus 755	R.A.F. Transport Command, 13; M. of S., 3	
	300-series	Proteus 755	M. of S., 1; Northeast 5	
	310-series	Proteus 755	B.O.A.C., 18; El Al, 3; C.P.A.L., 5; Hunting Clan, 2	
Douglas DC-7C Seven Seas	—	Wright R-3350	PanAm, 27 (current delivery); Swissair, 4 (current); S.A.S., 14 (current); Sabena, 9 (current); Braniff, 7 (summer 1956); B.O.A.C., 10 (October 1956); K.L.M., 10 (1957); Northwest, 8; R.E.A.L., 3; Panair, 4; T.A.I., 2; Alitalia, 4; C.M.A., 4; J.A.L., 4	110
Lockheed L.1649A Super Star Constellation	—	Wright R-3350	T.W.A., 24; Air France, 10; L.A.I., 4; Lufthansa, 4; Varig, 2 (Dec. 1957)	44
Convair 440 Metropolitan	—	Pratt and Whitney R-2800	R.E.A.L., 8; S.A.S., 16 (March 1956); Finnair, 2 (Feb. 1956 and Feb. 1957); Sabena, 12; Swissair, 11 (June 1956); Iberia, 5; Continental, 3 (Feb. 1956); National, 6; Delta, 8 (Jan. 1957); Eastern, 15 (May 1957); Braniff, 5; Alitalia, 2; Yugoslav Airlines, 1; Lufthansa, 9 (March 1957); Air Carrier Service, 2; R.A.A.F., 2; U.S.A.F., 6; Corporate customers, 9; Karhumaki Airways, 1 (June 1957); Ansett, 1 (June 1957); Italian A.F., 1 (July 1957); others 7	132
Sud-Est Caravelle		Rolls-Royce Avon RA.29	Air France, 12 (1958)	12
de Havilland Comet	4	Rolls-Royce Avon RA.29	B.O.A.C., 19 (mid-1958); Capital, 4 (Nov. 1958)	33
	4A	Rolls-Royce Avon RA.29	Capital, 10 (June 1959)	
Lockheed Electra		Allison 501	American, 35 (Aug. 1958); Eastern, 40 (Aug. 1958); Braniff, 9 (May 1959); National, 23 (April 1959); K.L.M., 12 (Sept. 1959); Western, 9 (late 1959); Allison, 1	129
Vickers Viscount	700 & 800 series	Rolls-Royce Dart	*See list below*	363
Vickers Vanguard	950 series	Rolls-Royce Tyne	B.E.A., 20 (March 1960); T.C.A., 20 (Aug. 1960)	40
Convair 880 Jetliner		General Electric CJ-805	T.W.A., 30 (late 1959); Delta, 10 (1959)	40
Fokker F.27 Friendship	Fokker-built	Rolls-Royce-Dart 511	K.L.M., 2; Aer Lingus, 5 (late 1958); T.A.A., 6 (early 1959); S.K.S. Air Transport, 2; Dutch Government, 1; "an Italian company", 1; Braathens, 3; Australian Government, 1; Iranian Oil, 2; Butler Air Transport, 5	73
	Fairchild-built		West Coast Air Lines, 4 (Nov. 1957); Mackey, 2 (Oct 1957.); Frontier, 2 (Oct. 1958); Bonanza, 3 (Feb. 1958); Piedmont, 12 (late 1957); General Tire and Rubber, 1 (1958); Continental Can Co., 1 (1958); Quebecair, 2 (early 1958); other U.S. executive versions, 4; Aerovias Ecuatorianas, 1 (early 1958); Northern Consolidated, 3; Aerolineas Argentinas, 10	
Handley Page Herald		Alvis Leonides Major	Queensland Airlines, A.N.A., and Lloyd Aero Colombiano—29; Air Kruise, 6	35
Frye Safari		Wright R-1300 or Pratt and Whitney R-1340	Wien Alaska, 3 (June 1957); Northern Consolidated, 3 (June 1957); Cruzeiro do Sul, 10 (end of 1957); Samoan Airlines, 2 (1958)	18

* An unspecified proportion of this total will be JT3 versions

Vickers-Armstrongs Viscount (all models) The following list of confirmed orders accounts for 363 aircraft, as follows: B.E.A., 26 V.701 (Dart 505), 1 V.701 (Dart 506), 24 V.802 (Dart 510), 14 V.806 (Dart 520); B.W.I.A., 4 V.702 (Dart 506); Aer Lingus, 4 V.707 (Dart 505), 3 V.808 (Dart 510); Air France, 12 V.708 (Dart 505); T.A.A., 6 V.720 (Dart 505/6), 1 V.720 (Dart 506), 5 V.756 (Dart 510), 2 V.816 (Dart 525); Indian Government, 1 V.723 (Dart 506), 1 V.730 (Dart 506); T.C.A., 15 V.724 (Dart 506), 21 V.757 (Dart 506); Hunting Clan, 3 V.732 (Dart 506), 2 V.759 (Dart 510); Pakistan Government, 1 V.734 (Dart 506); Iraqi Airways, 3 V.735 (Dart 510), 1 V.773 (Dart 510); Fred Olsen, 2 V.736 (Dart 506), 4 V.779 (Dart 510); Canadian Government, 1 V.737 (Dart 506); Misrair, 3 V.739 (Dart 506); Braathens, 1 V.742 (Dart 510); Capital, 3 V.744 (Dart 506), 72 V. 745 (Dart 510); Butler Air Transport, 2 V.747 (Dart 506); Central African Airways, 5 V.748 (Dart 510); L.A.V., 3 V.749 (Dart 506); B.O.A.C., 8 V.754 (Dart 510), 4 V.772 (Dart 506); Hong Kong, 2 V.760 (Dart 510); U.B.A., 3 V.761 (Dart 510); Hughes Tool Co., 1 V.763 (Dart 510); U.S. Steel Corp., 3 V.764 (Dart 510); Standard Oil, 1 V.765 (Dart 510); Indian Airlines, 10 V.768 (Dart 510); K.L.M., 9 V.803 (Dart 510); Transair, 2 V.804 (Dart 510); New Zealand N.A.C., 3 V.807 (Dart 510); Continental, 15 V.812 (Dart 525); Air Austria, 4 V.803 (Dart 510); South African Airways, 7 V.813 (Dart 525); Iranian Government, 3 V.782 (Dart 510); Lufthansa, 9 V.814 (Dart 525); Philippine Air Lines, 2 V.784 (Dart 510); L.A.I., 10 V.785 (Dart 510); South African Government, 1 V.781 (Dart 510); Pakistan Air Lines, 3 V.815 (Dart 525); Cubana, 3 V.755 (Dart 510), 4 V.818 (Dart 525); Lloyd Aero Colombiano, 3 V.770 (Dart 510); Brazilian Government, 1 V.770 (Dart 510); P.L.U.N.A., 3 V.770 (Dart 510); Niarchos, 1.

Twelve Viscount 800s may be seen in this latest picture of the erecting shops at Weybridge. Production this year from Weybridge and the other Viscount factory at Hurn will average one aircraft every three days.

On the other hand, turboprops can be shown to cut down direct operating costs by a considerable amount, provided that the aircraft can operate at a reasonably high altitude. One thing is certain; the aircraft should be designed around a powerplant which will be fully developed by the time the prototype appears but should be capable of using new and better powerplants."

The next step was to sort the engines into those which were already developed, those in the process of development, and a further group that were at an early development stage. An analysis of these divisions and the possibilities of fitting more powerful replacement engines at a later stage in the aircraft's development life led Shorts to comment: "It can be shown that an aircraft designed to take full advantage of a piston engine does not, as a rule, produce a very efficient aircraft when fitted with turboprops. On the other hand, an aircraft designed for turboprops from the start does makes a reasonably useful machine if fitted with piston engines. Since the future undoubtedly lies with the turboprop, therefore, the correct procedure seems to be to design for two of these." And the optimum choice for the Short P.D.16 was judged by the firm to be two Proteus 755 engines—which could eventually be replaced by Orions from the same stable.

With the number and type of powerplants settled, it was now possible to decide where to put the wing and tail. The wing position was not difficult to resolve. "It must be possible" ran the written thoughts of Shorts' engineers, "to get the floor of a freight aircraft near enough to the ground to allow goods to be loaded straight off the bed of a truck. This rules out a low wing position. A mid-wing position is structurally uneconomical unless the main hold is divided—obviously a bad arrangement. Therefore we shall choose the high wing position." The second point—the positioning and shape of the doors—was more difficult to settle. Military operators insist on large doors at the rear of the hold and civil operators want large doors but do not particularly mind which end of the fuselage they are. Some would prefer doors at both ends. Nose doors are easily incorporated on almost any configuration but large rear doors have a profound effect upon the design of tail unit and rear fuselage.

Four ways of making an aircraft with large rear doors were analysed: a twin-boom layout, a "tadpole" (Beverley) layout, a "beaver-tail" (Hercules) arrangement and a "pi-tail" twin-boom layout where the booms are extensions of the fuselage sides. Pi-tails and tadpoles were rejected because the former implied loading trucks approaching from directly aft and the latter presents severe pressurization problems between the joint in the upper surface of the doors and the underside of the tail boom. The beaver-tail offered better possibilities, but the ramp door might deteriorate with field use and fail to seal or, if made inward opening, would result in a poor fuselage shape and high drag.

Adoption of the twin-boom layout was not, however, the result of purely negative advantages. The possibility of varying the size and shape of the fuselage (and divorcing the pressurized structure from tail loads) led to an attractive versatility.

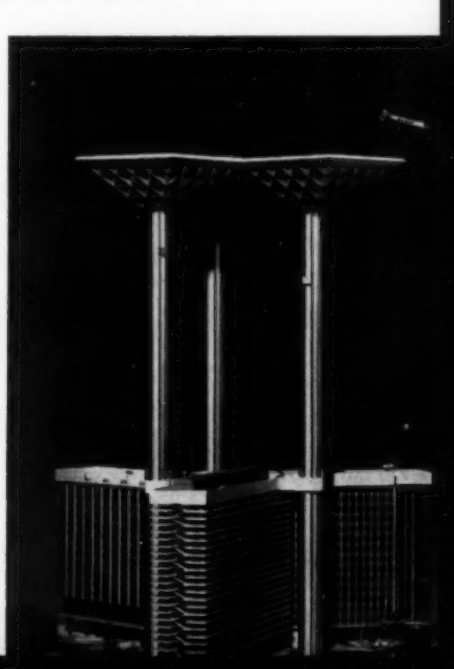
With weight, powerplant and configuration settled, the aircraft can be visualized and preliminary general arrangement drawings made. What performance should be aimed at? "The freighter should," states the brochure, "be able to go anywhere that a Dakota can go and carry twice the payload at twice the speed. The ability to operate from primitive airstrips . . . is essential.

"One of the more fashionable ways of improving field-length performance today is the use of 'flap-blowing'. Whilst this device provides an excellent way of improving the characteristics of a plain flap, it does not do very much to improve a well designed slotted flap. On a high-speed aircraft, having a very thin wing and jet engines, where the provision of good high-lift flaps is impossible and plenty of compressed air is available from the engines, flap blowing shows dividends. On an aircraft such as the Short P.D.16, however, it is doubtful whether it is worth while.

"Turboprop engines (as opposed to turbojets) are reluctant to supply much 'bled' air without serious loss of performance. It is possible that the amount which could economically be tapped off might just about bring the performance of a plain flap up to that of an unblown slotted flap. In this case, it is necessary to evaluate the weight and cost of the flap blowing installation against the extra complication of the slotted flap. The thing which turns the balance, of course, is the engine-cut case where the slotted flap wins all the way."

An unusual feature of the P.D.16 (which is apparent from a glance at the G.A. drawing published in *Flight* for February 8) is the large external fuel tanks. Shorts' reasons for stowing all the fuel in this way were to keep the cost, weight and complexity of the wing box-beam to a minimum. This they intended to do by using the least number of cutouts and joints in the beam, which would then be carried clear across the top of the fuselage and powerplants. "In spite of the drag of the tanks," they calculated, "the gains in wing beam weight and fuel system weight are overwhelming." Different size tanks could also be fitted for different missions and should be easy to refuel.

The honest hard thinking that the Short project study contains is revealing and convincing. Accusations of "brochuremanship" can carry no weight against such instructive balancing of advantages; we hope to see the release of more such studies.



Skyport One: The Glass Age Development Committee's imaginative V.T.O.L. and heliport project for St. Giles' circus, London—in A.D. 2000. The triple upper landing decks, supported on glass columns, would be 500ft above ground level and contain A.T.C., service departments and a revolving restaurant. Below them are a hotel, an "autosilo" park for private aircraft and cars, and offices.

Mr. J. D. Pearson, chief executive of Rolls-Royce, discusses with Mr. Harold Watkinson, Minister of Transport and Civil Aviation, tools and spare parts on display in the Rolls-Royce Aero Service building at London Airport, which was opened by the Minister last Friday.

CIVIL AVIATION...

ROLLS-ROYCE AT L.A.P.

AT London Airport last Friday, the Minister of Transport and Civil Aviation, Mr. Harold Watkinson, opened a new Rolls-Royce aero service building. Of functional design (and constructed of red brick) the building is situated to the south-east of B.E.A.'s engineering base, where it will provide spares facilities for every airline using London Airport and whose aircraft are powered by Rolls-Royce engines. With Merlin-Argonauts, Dart-Viscounts, Tyne-Vanguards, Avon-Comets and Caravelles and Conway-707s and DC-8s this will amount to a formidable total. The new office will serve a similar function to the Rolls-Royce facilities already established at Dorval, Montreal, and Kingsford Smith Airport, Sydney (Rolls-Royce service is available at 26 airports across the world). By providing an "over-the-counter" spares service the number of parts held by the airlines can be considerably reduced.

The Aero Service Office—which for last week's opening contained a selection of Rolls-Royce's beautifully prepared display engines—will largely comprise a parts store, but a team of the company's service engineers is accommodated in an adjoining office for the analysis of spares statistics.

Speaking at a luncheon before the opening ceremony, Mr. Watkinson said that the Rolls-Royce building made a most welcome addition to London Airport's service facilities; it fitted in well with the Ministry's policy of encouraging as many commercial enterprises as possible to join in development of the site.

Turning to the problems facing aircraft operators for whom Rolls-Royce were to provide customer-service, the Minister mentioned noise—one of the most difficult—and air traffic control. To this problem, he said, his department was devoting very close and detailed study. He appealed to the engine designers to develop "engines whose economic operation was less sensitive to height."

HUNTING-CLAN'S INTEREST IN C.A.A.

THE Hunting-Clan group of air transport companies, and the British and Commonwealth Shipping Company (which controls Clan Line and Union Castle) are negotiating in Salisbury with the Central African Government for the purchase of a controlling interest in Central African Airways Corporation (which last year lost £250,000). No details of the discussions have yet been disclosed, but it is understood that C.A.A. would remain as the national airline for the Central African Federation, retaining the name Central African Airways.

The Financial Times, whose correspondent reported on these negotiations on February 13, states that no secret has been made in Government circles of the fact that the Hunting-Clan move is strongly opposed both by B.O.A.C. and South African Airways.

ELECTRAS FOR AUSTRALIA?

THE Australian operator Ansett Airways, who have a fleet of six DC-3s, two Convair 340s and two Sandringham flying-boats, are reported in Melbourne (where the company is based), to be negotiating for the purchase of a fleet of Lockheed Electras. Another report states that the airline is also considering the purchase of Viscount 840s.

Ansett, whose suggested merger with Butler Air Transport of Sydney we now understand is unlikely to take place, operate DC-3s and Convairs to Tasmania, Adelaide, Sydney, Brisbane and other points as far north as Cairns. Delivery date for the Electras—the number is not disclosed—is stated to be 1959.

Another possible new Electra-purchaser, according to *Aviation Week*, is Loftleidir Icelandic Airlines.

B.E.A. TO SELL ELIZABETHAN FLEET

THE entire B.E.A. fleet of 19 Elizabethans is to be progressively withdrawn from service and disposed of by the autumn of 1958. The first two aircraft will come on the market in April, a further two in June and three more in July—a rate governed by the delivery of the Corporation's new Viscount 800 fleet. No mention has yet been made of a definite interest in the purchase of these aircraft, although a B.E.A. spokesman stated that the air attachés of South America and "other embassies" in London had already been informed that the aircraft were coming on to the market. The Elizabethan first entered full scheduled passenger service with B.E.A. in March 1952, and has more than held its own on B.E.A.'s international routes—particularly between London and Paris, where they have carried more than 750,000 passengers.

PRIVATE OWNERS' SYMPOSIUM

LAST Friday a symposium was organized by the Royal Aero Club and held at the Air Touring Centre, London, to allow private owners to meet representatives of the M.T.C.A. and many other organizations with which they often come in contact. M.T.C.A. departments, G.A.T.C.O., S.L.A.E., G.A.P.A.N., A.O.A., and the A.R.B. were represented; and more than three score of private owners forcefully made the most of their chance of putting their views.

Because the owners and the Ministry did not see eye to eye on the definition of helpfulness the discussion often became heated. It was apparent that the Ministry and the Board of Trade are weighed down by considerations of legality and procedure with which the average owner is not at all concerned. But the Ministry made a real effort to be helpful and granted at the meeting a number of concessions. One was that the maximum weight for aircraft permitted to use the red landing card was raised from 4,000 lb to 4,499 lb, thus including the Prentice. They promised also to prepare and pass to the R.Ae.C. a complete list of disused airfields and their owners so that application to land on or use them could be more readily obtained. On the other hand, the Ministry could not see its way to granting petrol-tax relief to private owners (as distinct from clubs); it could not convince itself that such relief was justified.

Working parties were already considering, the Ministry representatives said, the "hire and reward" regulations; and steps were being taken to find an alternative to Croydon for the private owner after 1958. A modified instrument rating was suggested to facilitate "special Visual Meteorological Conditions" flight clearance for private owners. The Board of Trade was asked to consider facilitating importation of modern light aircraft and also lightweight radio navigation aids.

Apart from positive concessions, the main good result of the meeting was to bring the various interests together and to let each know the other's viewpoint. The Ministry, we felt, did not come out too badly; and the A.R.B. in particular showed itself to be realistic and genuinely well-disposed towards the private owner.

BREVITIES

TO overcome the acute shortage of channels, the C.A.A. is considering using 50 kc/s spacing in the V.H.F. communications band. American ground stations with 200 kc/s spacing are now being replaced by the new standard 100 kc/s-spacing radios; coverage will be complete by the end of this year.

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Sir Frederick Tymms (Great Britain) and Walter Binaghi (Argentine) are candidates for the presidency of I.C.A.O. after Dr. Edward Warner, of the U.S.A., who is retiring.

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The chief British delegate to the Bermuda civil air transport conference which opened last Monday is Mr. A. H. Wilson, Deputy Secretary to the M.T.C.A.

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When Mr. Aristotle Onassis takes over the Greek airline T.A.E. (see *Flight*, August 10, 1956) "in the very near future" the name of the company will be changed to Olympic Airways.

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The overhaul period of the Rotol propellers on T.C.A. Viscounts has been increased to 2,100 hours.

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Capt. R. T. Merrifield has been elected chairman of the British Air Line Pilots Association in succession to Captain A. Spooner, who did not offer himself for re-election.

* * *

A six-man team from C.A.A. is discussing with the A.R.B. in London common civil airworthiness requirements for the Britannia, Viscount 810/840 and Comet 4 and 4A. A team from the A.R.B. has left for Seattle to examine the Boeing 707.